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Waste Audit Study: Automotive Repairs

Toy (Wesley M.), Saratoga, CA

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This document reports on a waste audit study which investigated and analyzed the automotive repair industry in California. It assessed current waste management practices and developed specific on-site and off-site waste treatment recycling alternatives. The conclusions identify and address illegal disposal practices. Recommendations include the segregation of specific wastes for proper disposal and economic analysis of on-site waste recycling equipment.

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WASTE AUDIT STUDY

AUTOMOTIVE REPAIRS

PREPARED FOR

ALTERNATIVE TECHNOLOGY SECTION
TOXIC SUBSTANCES CONTROL DIVISION
CALIFORNIA DEPARTMENT OF
HEALTH SERVICES

PREPARED BY

WESLEY M. TOY, P.E.
CONSULTING ENGINEER

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WASTE AUDIT STUDY ON AUTOMOTIVE REPAIRS

FINAL REPORT

Prepared for

Alternative Technology Section
Toxic Substances Control Division
California Department of Health Services

Prepared by

Wesley M. Toy, P.E.
18805 Cox Ave., Suite 120
Saratoga, Calif. 95070

(408) 374-4579

Abstract

This waste audit study investigates and analyses the automotive repair industry in California. It makes specific recommendations for the reduction of hazardous waste generated by this industry (SIC 7538 & 7539). The study performs an on-site evaluation of three firms to characterize the typical operations conducted. The firms audited are: 1) a medium-sized auto transmission business, 2) a large automotive dealership in Northern California, and 3) a large leasing and maintenance company for automotive parts cleaning equipment. The current waste management practices are assessed. Specific on-site and off-site waste treatment recycling alternatives are developed. The results are generalized to allow other firms in the industry to perform a self-audit. This report will help these firms to develop economical,commercially available waste management options.

The conclusions identify and address illegal disposal practices. Recommendations include the segregation of specific wastes for proper disposal and economic analysis of on-site waste recycling equipment. The computer spreadsheet template on Lotus 1-2-3™ is included in the report.

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This report was submitted in fulfillment of Contract No. 85-87158 by Wesley M. Toy, P.E. under the sponsorship of the Department of Health Services. The work was completed as of May 5, 1987.

Disclaimer

The Statements and conclusions of this report are those of the Contractor and not necessarily those of the State of California. The mention of commercial products, their source or their use in connection with material reported herein is not to be construed as either an actual or implied endorsement of such products.

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PART I

GENERAL STUDY

CHAPTER 1

EXECUTIVE SUMMARY AND CONCLUSIONS

1.1 General

This report provides a waste audit study of the automotive repair industry in California. The study performed individual audits on three firms of different sizes. The results are generalized to provide self-audit guidelines for other automotive service and repair operations. A self-audit can assess the level of waste generation, develop improved waste management methods, and/or uncover problems to be addressed.

Operations and practices which are typical in the industry are identified. The industry was studied at three operating types:

Medium size repair shops:	20 cars per week
Large dealerships:	500 cars per month
Large solvent and aqueous parts cleaning service for auto repairs:	700 auto repair shops

1.2 Hazardous Waste Control Levels

Six levels of solvent and aqueous hazardous waste controls are identified and applied to each of the above operating types:

Level 1. No control - once-through waste generation and disposal to municipal sewer or dumpster.

Level 2. Waste collection for proper disposal.

Level 3. On-site reuse equipment to minimize solution use or loss.

Level 4. Service company to provide off-site waste recovery or recycling.

Level 5. On-site waste reclaim equipment.

Level 6. Source Reduction and Improved Housekeeping

1.3 Waste Audit Study Results

The results presented are the information, alternatives, and specific vendors to minimize on-site waste generation that 1) limit illegal waste disposal, and 2) recycle and/or reduce volumes to be shipped off-site. These results can facilitate self-compliance with hazardous waste disposal regulations.

In general, this study shows segregation of solvent and aqueous waste by small to medium repair shops must be promoted. This would include additional regulatory or economic incentives. Many of these small businesses generate less than 10 gallons per month. These quantities can cost more for disposal than the original purchase price. Waste motor oils regularly picked up under different manifest variance permits are used as the vehicle for illegal disposal. Aqueous wastes often contain hazardous levels of grease, oil, and heavy metals. Many small shops illegally dispose of this to the municipal sewer, violating local regulations. This study shows that efficient use of a solvent service to supply and dispose of solvent wastes is an economical alternative.

1.4 Specific Areas of Non-Compliance and Compliance

Aqueous wastes are generated when a hot tank or jet spray is used to clean engine parts. Pick-up of the waste liquids and sludges can be provided by waste service companies with the proper shipping manifests. But in some cases, the waste hauler is dumping to the municipal sewer illegally. These problems are currently being identified and remedied by local and state enforcement agencies.

Large auto dealerships are often more aware of hazardous waste regulations. These firms comply with collection and manifesting requirements, have rigid maintenance standards, as well as the financial resources needed for compliance. These shops are aware of alternatives. In many cases a group of 5 or more dealerships obtain more favorable pricing from maintenance service companies. Small and medium sized automotive repair operations should be encouraged to form cooperatives through trade associations to obtain comparable pricing. This study also presents source reduction methods to reduce the quantity or degree of hazardous waste produced.

1.5 Source Reduction and Housekeeping

Significant quantities of waste can be eliminated by the proper operation of existing equipment, avoiding spills and using detergents in place of solvents. Solvent sinks, hot tanks and jet spray washers have proven effective in reducing waste. Use of drip trays and collection of solid residues from cleaning further controls waste discharges.

1.6 On-Site Solvent Recovery and Aqueous Waste Volume Reduction

Solvent reclamation equipment is becoming available for small scale on-site use. However, for most auto repair shops and dealerships the current economics for small solvent recovery devices are unattractive. A solvent still would have an 8 to 9 year payback period for even a large auto dealership at non-union labor rates (Appendix 3). On-site stills are not economical when union labor rates are applied. These are also uneconomical for small auto repair shops.

The economics are very favorable when the recovery equipment is installed at the solvent service level of operation. Solvent used at the rate of 2200 gallons per month will pay back the cost of a recovery system in 6 to 9 years with annual cost savings of $2,700 to $4,800 per year (Appendix 3). For 3700 gallons per month consumption, the savings are $8,000 to $9,000 per year for a 3 to 4 year payback on investment.

Technology for small scale on-site aqueous waste volume reduction has recently been adapted from larger scale uses. Evaporative .volume reduction for coolants, rinse waters, water-based inks, and alkaline cleaners at 14 gallons per hour have been downscaled and repriced for the 5 gallon per hour or less needed in the auto repair industries. These units can pay back in 3 to 5 years in non-union shops. Chemical treatment can produce a fixated sludge and sewerable water. However, the economics are unfavorable on-site at the small scale. For disposal off-site at larger scales of 5000 gallons per month, a pay-back period of 2 to 12 months is possible with yearly cost savings of $28,000 to $40,000 over Class 1 landfill disposal site costs. These economics only apply when and if Class 1 disposal site costs are imposed and incurred.

1.7 Application of Hazardous Waste Control Levels

The six levels of control listed above can identify current waste practices.

Solvent Wastes

Level 1, no control, is currently practiced by many small to medium operations. These can be upgraded to Level 2, collection; Level 3, on-site reuse (solvent sinks); and Level 4, solvent service for waste recovery by proper information and selective enforcement of existing disposal regulations. Most medium or large repair operations currently use solvent sinks and/or solvent services. An off-site solvent service will recycle the solvent by distillation, direct reuse, or use as waste fuel. The effort to be made here is to assure proper on-site solvent segregation by the repair shop. Level 5, on-site waste reclamation equipment, is only economical for an off-site solvent recycling firm at the present time. Level 6, source reduction and housekeeping, can include low cost, simple housekeeping improvements as well as major operational changes such as upgraded washing equipment or chemical substitutions.

Aqueous Wastes

The use of hot tanks and jet spray detergent washers for engine and transmission parts is prevalent in the industry. This covers most hazardous waste generation. This identifies a Level 3 application of reuse equipment. Most shops, small and large, have concluded that substantial labor savings are realized when these washers are used. Disposal of 10 to 80 gallons per device on a monthly basis is typical of most operations. The problem at this point is illegal discharge to the sewer. The technology for proper volume reduction is rudimentary at this time. It is not applied either at the source of generation or by the waste hauler. In other words, upgrading to Level 4 may not reduce illegal sewering.

Disposal to the municipal sewer at the repair shop is currently done either due to lack of information about the hazardous nature of this waste, or to avoid the expense of shipment and disposal at a Class 1 landfill. Currently, local jurisdictions are enforcing court orders to prohibit sewering of hazardous wastes at auto repair shops by waste haulers. An alternative is the installation of volume reduction equipment. Volume reduction of approximately 10 to 1 can provide a thick slurry. This can be stabilized for disposal at a Class 1 landfill. A combination of Level 4, service company providing off-site waste concentration, and Level 5, on-site volume reduction could provide this alternative. Both evaporative and chemical treatment methods are currently available. A combination of public information of current regulations, enforcement of existing regulations, and application of technology must occur to control these wastes.

CHAPTER 2

RECOMMENDATIONS

2.1 Solvent Wastes

This study shows that waste segregation at small to medium auto repair shops can be accomplished. For collection and disposal the waste oil recycler must obtain the proper manifest variances for solvents. Alternately, a hazardous waste hauler can pick up these waste solvents. Lease of solvent cleaning equipment with material supply and waste disposal provisions is another alternative. Use of on-site solvent recovery equipment is not favorable for processing less than 100 gallons per month at union labor rates for equipment operation and maintenance. On-site recovery could become economical if automotive body repair generated additional solvent waste from painting operations. Use of solvent recovery equipment by solvent sink service and maintenance operations is economically attractive and should be promoted.

2.2 Aqueous Waste

For aqueous wastes, on site use of hot tanks and jet sprays for waste minimization is already a part of normal operations. The equipment reuses the cleaning solution until its activity is spent. Extension of the life of the solution would occur by:

- prewash to minimize the introduction of oil and grease into the final wash solution. This can be accomplished by a pre-rinse with spent cleaning solution of parts to be cleaned,
- periodic or continuous removal of dissolved solids and heavy metal components by sludge removal or solids fixation. The use of filtration equipment or a periodic tank maintenance service to remove sludge material,
- the addition of fresh detergents can reactivate the spent cleaning solution.

On-site evaporative or chemical waste treatment equipment has marginal economics as to equipment maintenance services. These treatment methods can be favorable for an equipment leasing service company. A 2 to 12 month payback on the initial capital investment is possible.

Spent radiator solution is generated at 30 to 100 gallons per month by medium to large repair shops. This should be properly disposed of as a hazardous waste. Many smaller shops are not aware of this requirement, and are illegally sewering this waste. Some licensed waste haulers may ship this waste for processing as a waste fuel. (Section 8.3)

2.3 Oil Wastes

Waste engine oils in general are accumulated properly by large and small repair shops. Independent contractors properly manifest and refine these wastes for reuse.

2.4 Oily Solid Wastes

Oily soils high in heavy metals content are a significant hazardous waste generated by hot tank cleaning. Often this material is not properly disposed of by large and small operations alike. Typically it is taken off-site to local municipal dumps. Proper practice would be to identify the hazardous nature of this waste and provide shipment to a Class 1 land fill. This material accumulates in the waste sump of the pressure spray cleaning bays on-site.

CHAPTER 3

INTRODUCTION

3.1 Scope of Study

This study characterizes waste management practices of automotive repair shops (SIC 7538 & 7539) in California by performing waste audits on three selected firms. The results of the individual audits were evaluated to identify the hazardous waste control level. Specific recommendations are developed to identify and facilitate proper disposal of hazardous material wastes. Practices to isolate waste generated and options for waste disposal are provided.

In addition, specific equipment to allow recycle and reuse of parts cleaning solutions are identified. Suppliers as well as equipment leasing and maintenance services are listed. For each of the three companies audited the costs for waste management options are analyzed to develop specific payback periods.

A waste audit format is presented in Part II for the automotive repair industry. The format prescribes the steps and methods by which an individual firm can conduct its own waste audit. Hazardous materials used and generated on-site are identified. Management options, equipment suppliers and waste services are listed.

3.2 Industry Characteristics

The automotive repair industry is comprised of small quantity generators (SQG). These number the largest and heaviest producers of hazardous waste material of all SQG's. The two year survey of small quantity generators of hazardous waste issued by the Office of Solid Waste (OSW) was released on March 12, 1985 by the Environmental Protection Agency (EPA). It shows vehicle maintenance leading in numbers of generators (82,530 of 175,000) and highest in quantity of total waste produced (351,500 tons/year out of a total 760,000 tons/year) for SQG's. SQG's produce less than one-half of one percent of the hazardous waste produced nationally. However, the sheer number of SQG's pose human health and environmental risks. EPA defines an SQG as generating at least 220 pounds but less than 2,200 pounds of hazardous waste per month.

The automotive repair industry is composed of three primary segments, these are shown in Figure 3-1. Shown are those segments which produce the significant solvent and aqueous hazardous liquid wastes and sludges requiring disposal as hazardous waste. The areas which are used as representative of the industry and which produce the majority of wastes are automotive repair garages and new car dealerships.

3.3 Legislative Guidelines

These repair operations are regulated in California under the Hazardous Waste Control Law. In addition, these repair operations are also affected by the amendments to the Federal 1984 Resources Conservation and Recovery Act. The Act requires promulgation by March 31, 1986 of generation and management standards for hazardous waste produced by SQG's. Beginning August 5, 1985, SQG's were required to accompany off-site shipment of hazardous waste with a Uniform Hazardous Waste Manifest. This audit report provides specific methods to be used by SQG's for qualitative and quantitative identification of those materials which EPA has determined to be hazardous.

3.4 Limitations of Study

The conclusions and recommendations developed in this report apply typically to waste generation in the automotive repair industry. The processes studied are typical of the industry. However, the waste management practices observed may not necessarily be typical.

The alternatives developed are shown as typical of those commercially readily available. The study does not attempt to evaluate all equipment manufacturers and services currently available. Listings of available manufacturers and services are done on a similar basis.

Waste disposal costs were based upon waste disposal services available in the Northern California area. They may not necessarily represent costs in other areas.

The study does not include automotive body repair or painting. The study does not include hazardous materials fixated in discarded auto parts with the exception of batteries.

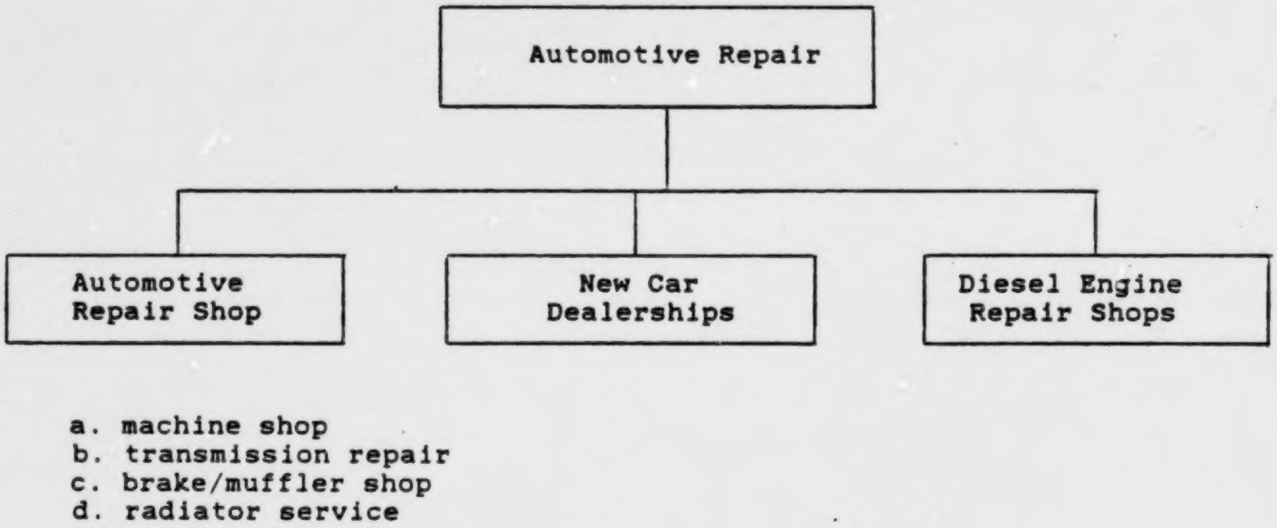
REFERENCES FOR CHAPTER 3

References for Section 3.2

1. U.S.Environmental Protection Agency (USEPA), Office of Solid Waste and Emergency Response. Survey of Small Quantity Generators. Washington D.C., 1985.

Figure 3-1

Segments of the Automotive Repair Industry
Generating Significant Hazardous Wastes


Automotive Repair
Automotive Repair Shop
New Car Dealerships
Diesel Engine Repair Shops
a. machine shop
b. transmission repair
c. brake/muffler shop
d. radiator service

CHAPTER 4

DESCRIPTION OF FACILITIES AUDITED

4.1 Waste Audit Study Participants

The following three companies were audited to assemble the industry characteristics used in this report.

Table 4-1

Participants in Waste Audit Study

Name of Company	Facility Size	Type of Business
Firm A	20 cars per week	complete automotive repair specializing in transmission and engine maintenance
Firm B	500 cars per month	auto dealership offering new car maintenance and service
Firm C	700 auto repair firms serviced	auto parts cleaning. Major supplier of leased auto parts cleaning tanks and chemicals.

The participants in this study are ideally suited to characterize the industry being audited. Firm A is representative of many small to medium auto repair shops. With 15 years of auto engine repair and maintenance experience, it represents an established auto repair shop. Parts cleaning operations on engine, transmission and differential repairs run the spectrum of engine drive train repairs. It services approximately 20 cars per week. The second firm agreeing to participate in this study, Firm B, is a large automotive dealership in Northern California. Firm B services in its repair shop, 500 cars and trucks per month, and sells 300 cars or trucks per month. Firm C provides a larger sampling of the wastes produced in the Northern California area. Firm C leases solvent sinks and parts washing equipment to over 700 auto repair firms. These range from large dealerships to small repair shops servicing an area from Redding to Reno to Salinas. The company sells the solvents and detergents used in its equipment. It recovers, processes, and disposes of the hazardous waste materials produced.

4.2 Plant Selection Criteria

The firms shown in Table 4-1 were selected to be included in the study because they represent the range of repair shop processes normally performed in automotive maintenance. Secondly, the facility sizes included encompass a wide range, from a small independent shop to a large automotive dealership in Northern California, to a parts washer lease and service company.

The facilities are inter-related by the services which Firm C provides. Firm A has a lease and maintenance contract with Firm C for one of its jet spray parts washers. Also, Firm B has a lease and maintenance contract with Firm C for two hot tank cleaning devices. Each of these devices are described in Section 5.2.

Table 4-2 shows the types and percentages of services provided at Firms A and B.

Table 4-3 shows parts cleaning equipment used by Firms A and B as well as the equipment leased and serviced by Firm C.

4.3 Waste Audit Study Benefits

These three companies have willingly participated in this study. Each benefited by the information which was developed. Each has the financial resources and incentives to implement the recommendations developed.

Firm A benefited from the information on solvent waste isolation for proper disposal and the available methods and costs to perform this properly.

Firm B appreciated the economic analyses which were supplied for the use of on-site solvent recovery and aqueous waste reduction equipment.

Firm C was supplied with a timely analysis of equipment options and economics on on-site aqueous waste volume reduction equipment. They have installed evaporative waste volume reduction equipment on an interim basis. They plan to go to a more comprehensive chemical batch treatment system based upon the results of this study.

Table 4-2

Services Performed by Individual Audit Firms

Service Provided	Firm A		Firm B	
	%	Vehicles per mo.	%	Vehicles per mo.
Periodic auto maintenance	-		25	125
Transmission maintenance	60	52	5	25
Engine repair	10	9	10-12	50
Brake servicing	20	18	2-3	10
Front end alignment	-		4-5	20
Light duty, noise, warranty work	-		30-35	150
Tune-up	-		10	50
Other	10	9	5	25
Total	100	88	100	500

Table 4-3

Parts Cleaning Equipment Used and/or Serviced by Audited Firms

Equipment	Firm A Equipment Used & Serviced	Firm B Equipment Used & Serviced	Firm C Equipment Serviced
Hot Tank	-	2	300
Jet Spray	1	-	38
Solvent Sink	-	10	340

CHAPTER 5

CHARACTERIZATION OF AUTOMOTIVE REPAIR OPERATIONS

5.1 Segments of Audits

The waste audits of the three businesses selected for this study were performed in four steps.

5.1.1 Step 1 - Initial plant visit

- process configuration and facility waste generation locations identified

5.1.2 Step 2 - Second plant visit

- fresh material used and waste material produced quantities identified
- sampling of waste streams for analysis

5.1.3 Step 3 - Development of process modifications, waste disposal alternatives, and identification of on-site processes for waste volume reduction. Application of process technologies and disposal alternatives to develop control economics.

5.1.4 Step 4 - Preparation and presentation of individual site audits with recommendations to facility owners. Appendix 1 contains waste audits for Firm A, Firm B, and Firm C

These waste audits are divided into two sections. Section 1 characterizes the current operations and disposal practices for each site. Section 2 provides the waste management options for each of the specific wastes identified. The process economics, equipment suppliers and costs are also provided in Section 2 of the audit.

5.2 Automotive Parts Cleaning Operations

Currently most automotive repair businesses use equipment to minimize solvent or cleaning solution use and losses. These devices can also be viewed as control or containment vessels of hazardous waste materials. The operation and maintenance of these devices usually provides the key to control of the majority of uncontrolled liquid hazardous wastes generated on-site.

Types of Equipment

Parts washers can be categorized as solvent parts washers, hot tanks, jet spray washers, ultrasonic cleaners, steam cleaners and bake-off ovens. The devices used primarily are solvent parts washers, hot tanks and jet spray washers. Ultrasonic cleaners have not been adapted to handle the waste loading found in the industry. Bake-off ovens leave a solid residue which must be cleaned off by further mechanical cleaning.

Description of Equipment and Equipment Operation

A description of the solvent parts washer, jet spray washer, and hot tank leased by Firm C are shown in Appendix 7. Solvent parts washers, hot tanks, and pressure cleaning chambers are self-contained baths with recirculating and/or agitated compartments. The solution is used and replaced on a 1 to 3 month schedule depending on the degree of use. Appendix 6 has the Material Safety Data Sheet (MSDS) for the petroleum distillate solvent used in the solvent parts washer. Appendix 6 also has MSDS's for caustic and detergent based cleaners for ferrous and aluminum based metals used in the hot tank. Similar materials are used in the pressure cleaning chamber. The MSDS for a typical carburetor cleaner with 45% methylene chloride, 5% 1,1,1 trichloroethane and 15% cresylic acid is shown in Appendix 6. Carburetor cleaners may or may not be used with a small agitator type cleaning chamber.

Equipment Operation

The solvent parts washer recirculates solvent continuously from the solvent drum to the solvent wash tray where the parts are cleaned. Solvent is normally replaced with fresh solvent on a monthly basis. The hot tank uses an electrically heated aqueous detergent solution which cleans parts immersed in the solution. The tank may be equipped with air or mechanical agitation. Hot tanks usually operate at 180°F. The jet spray washer uses an electrically heated aqueous wash solution also. Parts are suspended in the washer and rotating water jets spray the parts to perform the cleaning. Both hot tanks and jet sprays are usually serviced monthly by removing 10 gallons of liquid and sludge and recharging the solution with detergent.

Typical Equipment Used at Specific Types of Sites

Typically, a transmission repair business will have a single jet spray washer and possibly one solvent sink. A typical auto machine shop would have one solvent sink and neither a jet spray or hot tank. A typical auto dealership might have several solvent sinks, a hot tank, and no jet spray washer. In most cases the equipment would be owned and serviced by the business with no outside maintenance service contractor.

Hot tanks are prevalent in the industry for removing oil, grease and dirt from large engine parts. Jet spray washers are not as prevalent, but considered essential in many transmission repair operations. Solvent sinks are universally used in most engine repair operations.

Table 11-1 lists the major equipment manufacturers in California.

5.3 Repair Operations and Quantities of Hazardous Wastes Generated

Typical operations generating hazardous wastes were shown in Tables 4-2 and 4-3. These can be generalized as those processes for engine parts and equipment cleaning, those processes for oil and grease removal, and wastes generated by solution replacements during engine maintenance.

Table 5-1 provides a description of materials and wastes.

Table 5-1

TYPICAL AUTO REPAIR OPERATIONS WITH MATERIALS USED AND WASTE PRODUCTS PRODUCED

PROCESS OPERATION	TYPICAL MATERIALS USED	TYPICAL MATERIAL INGREDIENTS ON LABEL	GENERAL TYPES OF WASTES GENERATED
Oil & Grease Removal	degreasers-(gunk), carburetor cleaners, engine cleaners, varsol, solvents, acids/alkalis	petroleum distillates, aromatic hydrocarbons, mineral spirits	ignitable wastes, spent solvents, combustible slds. waste acid/alk. solutions
Engine, parts and equipment cleaning	degreasers-(gunk), carburetor cleaners, engine cleaners, solvents, acids/alkalis cleaning fluids	petroleum distillates, aromatic hydrocarbons, mineral spirits benzene, toluene, petroleum naptha	ignitable wastes, spent solvents, combustible slds. waste acid/alk. solutions
Solution replacement	antifreeze solution, petroleum oil	ethylene glycol, petroleum distillates,	hazardous liquid combustible liq.

Table 5-2 provides the waste generation rates at the three sites audited. The majority of wastes produced are in the form of:

- waste parts cleaning solutions and other miscellaneous detergent wastes
  - solvent cleaning solutions
  - aqueous detergent or caustic cleaning solutions
  - carburetor cleaners
  - aqueous floor cleaning detergents
- oil and grease removal wastes from engine cleaning
  - hot tank sludges
  - engine spray cleaning waste solids
- spent automotive fluids and batteries
  - waste anti-freeze solution
  - waste engine oil
  - spent automotive transmission fluids
  - spent automotive batteries

This report provides recommendations for the proper isolation of each of these types of wastes for proper disposal and/or for volume reduction.

Worn or replaced automotive parts such as brake shoes or pads containing asbestos, and mufflers or shock absorbers containing hazardous components are not studied here since the hazardous components are fixated in the waste parts.

TABLE 5-2

AUTOMOTIVE REPAIR HAZARDOUS WASTES GENERATED BY AUDITED FIRMS

				FIRM A		FIRM B		FIRM C	
WASTE	DOT SHIPPING NAME	HAZARD CLASS	NUMBER	GAL/MO	LB/MO	GAL/MO	LB/MO	GAL/MO	LB/M
Spent solvent	Waste Petroleum Dist.	Combustible Liquid	UN 1268	7	54	80	616	2200	1694
Aqueous detergent or caustic wastes	Waste Corr.Liquid N.O.S.	Corrosive Liquid	UN 1760	90	756	20	168	2000	1740
Carburetor cleaner	Waste Cpd. Cleaning Liquid	Corrosive Liquid	NA 1760	8	78	10	98	13	127
Antifreeze solution	Waste Liquid	ORM-E	UN 9189	32	282	100	880	-	-
Engine oil	Waste Petroleum Oil	Combustible Liquid	NA 1270	55	385	300	2100	-	-
Oily dirt w.high metals	Waste Corr.Solid N.O.S.	Corrosive Solid	UN 1759	-	0	NA	NA	<20	<500
Spent Sawdust	Waste Corr.Solid N.O.S.	Hazardous Solid	UN 1759		110		550	-	-
Lead-acid batteries	Lead Dross Cont. >3% free acid	ORM-C	NA 1/94	3 bat.	105	10 bat.	350	-	-
Detergent Soln. from floor wash	Waste Corr.Liquid N.O.S.	Corrosive Liquid	UN 1760	-	0	NA	NA	-	-

NA - Not Available

5.4. Quantitative Analysis of Waste Streams

The nature of the automotive repair industry and the hazardous wastes which are generated does not lend itself to controlling wastes by material balance calculations. As described in Section 5.3, waste products from this industry are generally as a result of parts cleaning operations or spent engine fluids or automotive batteries. Hence, hazardous wastes are accumulated from an undefinable residue being removed from automotive parts.

Samples of the hazardous wastes for this study allowed a comparison of the degree of contamination of waste materials at the different levels of plant operation audited. All waste streams identified in Section 5.3 except engine oils, detergent solutions from floor wash and spent automotive batteries were sampled and analyzed. These results are summarized in Appendix 2. Highlights of Appendix 2 are in Table 5-3 (pg. 19). The current municipal sewer ordinance standards for the city of Sunnyvale, CA and San Jose, CA are shown for aqueous liquid wastes. Solvents and carburetor cleaner wastes are discussed in Sections 8.1 and 8.2.

Aqueous Waste Analyses

The selected chemical analyses in Table 5-3 are for hot tank and jet spray liquids. As shown, apparently high levels of lead, chromium , zinc and arsenic make these solutions non-sewerable. (More comprehensive analyses are shown in Appendix 2.) The analyses were performed by standard methods but were not performed in a laboratory certified by the State of California. That should be taken into consideration when making decisions or conclusions based upon these results. Additionally, analysis by standard methods may have produced erroneously high results for mercury and selenium due to matrix effects caused by silica interaction.

A pH of 11 to 12 exceeds the maximum 10.5 local regulatory limitation on discharges to the sanitary sewer. An oil and grease content of 0.072% to 1.82% exceeds the 0.01% regulatory limit. The 5% to 20% solids present with the liquids contain substantially higher concentrations of the above species. These types of parts washers operate by emulsifying the oils and greases present with detergents and maintaining the heavy metals in solution. The solution loses its activity when the solution is saturated either with oil and grease, or metal species.

The solution must then be reactivated by reduction in both oil and grease, and heavy metal components, and the addition of fresh detergent.

General Observations

A few general observations can be made from the analytical results:

a. Liquid waste streams exhibited greater degrees of contamination with longer use as anticipated. ie. Solvent wastes were less contaminated than hot tank/jet spray wastes which were less contaminated than carburetor cleaning solutions.

b. Solid residues separated from the liquid samples tended to have higher metal concentrations in almost all components.

c. Antifreeze solution exceeded the municipal sewer standards for copper and mercury. In addition, antifreeze solution is considered a hazardous waste due to its LD_{50} toxicity levels (Appendix 5).

d. A high heavy metals and oil content was found in the dry solid residue from hot tank wastes and from the steam cleaning sump residues.

TABLE 5-3

SELECTED RESULTS OF CHEMICAL ANALYSES OF HAZARDOUS WASTES FROM AUTOMOTIVE REPAIRS (1)

SITE	SAMPLE #	DESCRIPTION		pH	OIL %	HEAVY METAL CONCENTRATION, PPM (2)											
						Cr			Pb			Zn			As		
						L	S	T	L	S	T	L	S	T	L	S	T
		SOLVENTS															
FIRM A	B	SOLVENT BUCKET		6.0		0.06	0.30	0.36	0.20	0.20	0.4	0.80	2.70	3.5	5.20	7.20	12.4
FIRM B	M	SOLVENT SINK		6.0		<.01	0.20	0.2	0.07	0.30	0.37	0.13	1.61	1.74	7.80	<1	7.8
FIRM C	F	SOLVENT DRUM as Recd.		6.0		0.02	0.40	0.42	0.56	0.17	0.73	0.54	5.80	6.34	5.00	7.20	12.2
FIRM C	H	HOLDING TANK + RESIDUE		6.0		0.60	31.0	31.6	4.70	327	331.	2.80	395	397.	3.60	8.00	11.6
FIRM A	C	CARBURETOR CLEANER		6.8		376	139	515	60.3	0.20	60.5	5.90	5.20	11.1	6.30	7.20	13.5
		SOLIDS															
FIRM C	E	HOT TANK - Dry Resid.		12.5	-	-	17.1	17.1	-	1035	1035	-	348	348	-	12.6	12.6
FIRM C	J	STEAM CLEANING SUMP		10.5	-	-	27.0	27	-	1455	1455	-	5.90	5.9	-	27.0	27
		AQUEOUS															
FIRM A	N	JET SPRAY		9.5	0.349	2.00	2.00	4	2.60	5.10	7.7	4.52	4.90	9.42	4.00	4.40	8.4
FIRM B	K	HOT TANK - Al		12.0	0.340	0.20	0.08	0.28	33.6	82.6	116.	3.70	1.40	5.1	6.40	4.90	11.3
FIRM B	L	HOT TANK - Fe		11.0	0.072	0.30	3.30	3.6	1.00	4.78	5.78	0.50	1.54	2.04	9.90	7.00	16.9
FIRM C	D	HOT TANK - COMPOSITE		12.0	1.860	0.26	13.0	13.2	40.0	70.0	110	5.60	5.40	11	11.0	6.00	17
FIRM B	O	RADIATOR SOLUTION		8.5		0.05	0.20	0.25	0.06	1.20	1.26	0.22	2.50	2.72	<1	1.40	1.4
STANDARD		MUNICIPAL SEWER - SVL	MAX	10.5	0.010			1.7			0.5			1.48			0.3
			MIN	5.0													
		MUNICIPAL SEWER - SJ	MAX	10.5	0.015			1.0			0.4			2.60			1.0
			MIN	5.0													

L - LIQUID   S - SOLID   T - TOTAL

(1) Selected from Appendix 2 based upon high concentration levels of the hazardous components

(2) ppm of metals based upon the total sample taken. Liquid and solid components are additive to obtain total solution concentrations.

CHAPTER 6

SOURCE REDUCTION

The following discussion relates to source reduction guidelines which were developed in performing the waste audits for the three individual firms audited.

6.1 Product Reformulation

The auto repair industry has reformulated the carburetor cleaner compound to exclude the use of 1,1,1 trichloroethane which had been used in typically 5% concentrations with methylene chloride and cresylic acid. 1,1,1 trichloroethane is a known irritant absorbed through the skin.

6.2 Safe Substitution

Where possible, hot tank and jet spray wash solutions are formulated with detergent based compounds instead of caustic based compounds. This trend is continuing with the changeover to aluminum engine blocks in place of the ferrous metals which require caustic solutions.

6.3 Plant Modernization

The use of solvent sinks for parts washing either on an owned or leased basis is being accepted as general good practice. Solvent reuse and waste containment are ideal features in this practice. The economics of the contracted service are also favorable, considering the current on-site labor costs for equipment maintenance and off-site disposal.

6.4 Improvements in Operating Practice to Minimize Losses

The addition of drip trays to both solvent sinks and hot tanks would be beneficial to capture these losses. Solvent losses between 25% and 40% are typical for Safe-Way Chemical. These are due to spillage as well as unauthorized uses (example - floor cleaning) for the solvent where the solvent is not recovered.

Secondly, the majority of the heavy metal residue, oil and grease removed from hot tank operations occurs after the actual hot tank use. The heavier concentrations of waste residues are found in the waste sump. This was shown in Table 5-3 and Appendix 2, and described in Section 5.4. Standard practice currently is to use a high-velocity spray wand to dislodge these solids into the sump. Proper capture and disposal of these wastes is necessary. This can be done by use of a solids collection tray with overflow to the sump or periodic cleanout of the sump by a waste hauler for disposal at a Class 1 landfill.

6.5 Two Stage Parts Cleaning

The bulk of the oil, grease, and heavy metal residues which are removed in jet spray parts cleaning operations. This occurs with the initial exposure to the wash solutions. In certain repair operations where there are a substantial quantity of parts to be processed, a two stage cleaning operation would provide clean parts in shorter times by using two washing devices in series. The first device would remove the heaviest residue, and the second device would provide the finish cleaning.

CHAPTER 7

ON-SITE RECYCLING, RESOURCE RECOVERY AND TREATMENT

This section will describe the alternatives for on-site recycling and resource recovery. These will be presented in two major areas:

- Equipment and processes for on-site recycling
- Management practices to aid recycling and resource recovery

The most appropriate and economic level of application of each treatment and recycling alternative is developed in Chapter 11.

7.1 Equipment and Processes

This category applies to the solvent and aqueous parts cleaning solutions identified in Section 5.3. The processes evaluated are solvent recovery by distillation and aqueous waste volume reduction by evaporation and concentration of sludges. Additionally, filtration extends the life of aqueous wash solutions by removing hazardous solids.

7.1.1 Solvent Waste Recycling

Table 7-1 identifies the equipment evaluated. Both of these manufacturers supply a range of equipment sizes.

Table 7-1
SOLVENT RECOVERY EQUIPMENT SUPPLIERS AND EQUIPMENT CHARACTERISTICS

Supplier	Model	Capacity	Equipment Cost	Temp. Limit (°F)
Recyclene Products, Inc.	R-2	5 gal./4 hr.	$2,495	<375°
405 Eccles Ave.	RS-20	5 - 7 gph (1)	$11,000	<375°
S.San Francisco,CA 94080	RS-35AF	6 - 8 gph (2)	$21,000	<375°
(415) 589-9600	RX-35AF	12-16 gph (2)	$25,850	<375°
Solvent Distlln.Equip.	LS-Jr.	5 gal./8 hr.	$2,995	<320°
Finish Engineering Co.	LS-15	15 gal./8 hr.	$5,895	<320°
921 Greengarden Rd.	LS-15V	15 gal./8 hr.	$9,390	<500°
Erie, PA 16501				
(814) 455-4478 & (415) 821-4154				

Notes: (1) 4 hours per cycle (2) Continuous operation
Cost Data: November, 1986

Appendix 7, Vendor Literature - Recyclene Products, Inc. describes some equipment available. Model R-2 can reclaim 5 gallons of solvent within 4 hours. The higher capacity unit RS-35 AF is capable of 6 to 8 gallons per hour on a continuous basis.

The Recyclene equipment uses a non-pressurized chamber with a teflon liner and electrical heating to distill the solvent. Water cooling is used to condense the vapors on the cover of the R-2. A shell and tube heat exchanger is used on the RS-20, RS-35AF and RX-35AF units. The solvent is drained to an external receiver.

The Finish Engineering equipment works on a similar principle. Vendor literature for their models LS-Jr. and LS-15 is in Appendix 7.

Comparative economics are shown below:

APPLICATION				RECYCLENE MODEL				SOLVENT DIST.EQUIP. MODEL		
SITE	SIZE	GAL/MO	LABOR RATE	R-2	RS-20	RX35-AF	RS35-AF	LS-15	LS-15V	LS-55 II
FIRM A	20 CARS PER WEEK	10	$20.00	<------	------	NEGATIVE	PAYBACK	ECONOMICS	------	------>
FIRM B	500 CARS	70	$38.00	<------	------	NEGATIVE	PAYBACK	ECONOMICS	------	------>
	PER MONTH	70	$8.40	9.8 YR	21.9 YR	-	NA	8.5 YR	14.7 YR	-
FIRM C	700 AUTO REPAIR SHOPS	2200	$11.00	-	-	8.5 YR	6.5 YR	-	-	8.8 YR

The bases for these results are:

Firm A: one solvent sink in operation with charges of $16.50 per month for fresh solvent and cost of capital at 6% per annum

Firm B: 10 solvent sinks in operation, current charges of $31.20 per month per sink for solvent sink lease and maintenance service, and cost of capital at 6% per annum.

Firm C: 3800 gallons of fresh solvent required per month, loss of credit of $0.15 per gallon for spent solvent sales, fresh solvent costs of $0.745 per gallon, and cost of capital at 6% per annum.

Discussion of Results

The results show the low volume of solvent normally used at most small to medium repair operations do not justify the added expense of additional equipment and maintenance costs. The larger operations such as Firm B do generate significant volumes of solvent. However, the labor costs to operate the equipment and additional costs for disposal of waste residues are not competitive with current solvent sink lease and maintenance service operations. Only when there are substantial volumes to be recycled do the economics produce results of 6.5 to 8.5 years payback on investment. An example is Firm C where 700 repair operations are serviced.

The detailed results for each of these calculations are presented in Appendix 3 under On-Site Solvent Recovery Options.

7.1.2 On-site - Aqueous Wastes Volume Reduction

The suppliers of aqueous waste reduction equipment evaluated are shown in Table 7-2. The types of equipment chosen are for evaporative waste concentration (D&K and Nordale), chemical batch treatment (Wastewater Treatment Systems) and filtration. These represent processes presently commercially available for the scale of operation evaluated.

TABLE 7-2

AQUEOUS WASTE VOLUME REDUCTION SUPPLIERS
AND
EQUIPMENT CHARACTERISTICS

Supplier	Model	Equipment Capacity	Cost
D & K Sales 1433 Lidcombe Ave. So.El Monte, CA 91733 (818) 575-1644	EVAP-85E	85 gallons	$1,995
Nordale Fluid Eliminator 990 Xylite Ave., N.E. Minneapolis, MN 55434 (603) 668-7111 (714) 855-0691	FE-150	150 gallons	$8,000 to $13,000
Wastewater Treatment Sys 440 N. Central Ave. Campbell, CA 95008 (408) 374-3030	_	50 gallons	$15,000 to $18,000

Cost Data: November, 1986

Evaporative Waste Treatment

Evaporative waste concentration drives off water by applying heat to the solution leaving a slurry or semi-dry cake. Problems include the presence of oil which inhibits boiling. Also the solid residue inhibits heat transfer to the solution. Both of these problems are being overcome. The D&K Sales EVAP has just come on the market and is gaining acceptance. The Nordale Fluid Eliminator is provided for comparison. It has not been fully adapted for this application. Chemical treatment (neutralization, precipitation and solids stabilization) has been fully proven. The evaluation shows it economic at the larger scale of application.

The D&K Sales Model EVAP-85 waste evaporator is described in Appendix 7. The equipment processes up to 85 gallons in a batch. Waste oils are skimmed off mechanically for each batch. Waste is pumped into the unit by a vendor-supplied pump. The waste is heated electrically at the bottom plate of the holding tank. Water vapor is drawn off by channeling air through the holding tank with an induced draft fan. Solids accumulate on the bottom of the tank as the water is driven off.

Appendix 7 provides the vendor literature for the Nordale Fluid Evaporator, Model FE-150. The equipment operates with the same concept as the D&K Sales equipment, but uses natural gas to heat the waste solution.

Chemical Waste Treatment

Aqueous hazardous waste is neutralized and precipitated chemically in the Wastewater Treatment Systems Batchmaster equipment for heavy metals reduction. Appendix 7 provides the vendor literature. Our evaluation uses the Batchmaster Models 50 or 200, having 50 or 200 gallons capacity.

The Batchmaster initially treats each batch with a cation polymer to float off dissolved oil and grease. Sulfuric acid is added to adjust the pH to between 2 and 3 where chrome species can be converted from valence +6 to valence +3. Metabisulfites are added to precipitate the chrome. The pH is then raised to between 9 and 10 with sodium hydroxide. At this point nickel, remaining chromium, and cadmium species are precipitated. The settled sludge is pumped from the bottom of the vessel. The treated water is decanted off the top. The equipment includes a filter press to stabilize the solids at a 50% moisture content.

Comparative Economics are shown below:

APPLICATION				D&K SALES	NORDALE	WASTEWATER TREATMENT SYSTEMS	
			LABOR	MODEL	MODEL	MODEL	
SITE	SIZE	GAL/MO	RATE	85E	FE-150	BM-50	BM-200
FIRM A	20 CARS PER WEEK	90	$20.00	3 YR.	11 YR	<—NEGATIVE—>	
FIRM B	500 CARS PER MONTH	20	$38.00	4 YR.	20 YR	<—NEGATIVE—>	
FIRM C	700 AUTO REPAIR SHOPS	2000	$11.00	3 MO.	6 MO.	2 YR	2 YR.
		5000	$11.00	2 MO.	3 MO.	1.5 YR.	1 YR.

The bases for these results are:

Firm A: One 85 gallon jet spray in operation with current monthly leasing costs of $242.

Firm B: Two hot tanks in operation, with current charges of $93 per month per hot tank for equipment leasing and service.

Cost of capital was set at 6% per annum. Waste volume reduction of 10 to 1 was achieved with the evaporative waste equipment. Waste disposal at a Class 1 landfill had costs of $115 per drum of stabilized waste, and $35 per drum of stabilized solid wastes. Additional costs are incurred for transportation and lab analysis. Appendix 4, Kettleman Hills Treatment Disposal Rate Schedule provides Class 1 disposal costs.

Discussion of Results

The results show the D&K Sales equipment has a 3 to 4 year payback for most medium to large repair operations. The equipment can be improved by adding a filter press to provide a stabilized cake. The chemical treatment methods by Wastewater Treatment Systems currently are only economic at the larger scales of operation. The Nordale equipment resulted in long payback economics at the medium repair shop or large dealership scales of operation. At the larger scales of operation, greater yearly cost savings are realized with chemical treatment technology, even though the evaporation equipment had shorter paybacks due to the lower capital costs. For this reason, the chemical treatment system is preferred. Payback periods are given at both 2000 and 5000 gallons per month to take into account current and anticipated future economics. The individual audit presented only the anticipated economics.

Filtration

In one application, a 25 micron filter bag on a slipstream from the jet spray washers extended the life of the detergent solution. The normal period between solution changes had been on the order of 2 to 4 weeks. By providing a pump-around loop through the 25 micron filter bag, solution life could be extended an additional 2 weeks before additional filtration was necessary.

7.2 Improved Management Practices

Many automotive repair operations combine solvents and carburetor cleaners with waste oils, resulting in waste management problems. The following practices do not represent all possible alternatives in this area, but only those which would provide immediate benefits.

7.2.1 Solvent Segregation

Proper manifesting and recovery of spent solvent solutions can only occur if small and medium repair operations segregate solvent wastes. Current practice at many operations is to commingle the wastes with the waste oil. Waste oils are manifested under NA 1270, Waste Petroleum Oil. Spent solvent wastes are manifested as UN 1268 or UN 1255, Waste Petroleum Distillate as a combustible liquid hazard class.

7.2.2 Carburetor Cleaner Segregation

Similarly, carburetor cleaner is often mixed with waste oils. Carburetor cleaner is a corrosive liquid manifested under NA 1760. This waste should be accumulated separately for proper waste management.

7.2.3 Incentives to Process Small Quantities of Waste

Given the current poor economics for on-site recycling of spent solvents (see Section 7.1.1), greater incentives are needed to promote use of a solvent service to pick up these wastes. This would be for generators with or without the use of leased solvent equipment. Typical quantity for pickup is 55 gallons. This must be economical in order to be picked up. Chapter 11 analyzes the economics for waste hauler pickup of wastes. Most small to medium repair shops cannot justify the economics.

7.2.4 Good Housekeeping Practices

Good housekeeping practices can minimize losses to the municipal or storm sewer. Typical examples would include the following:

- an employee education program for hazardous wastes disposal procedures
- proper on-site labelling of hazardous wastes
- separate containers for hazardous wastes
- convenient location of cleaning equipment to automotive service bays
- proper trash/solids separation prior to collection for waste recycling or treatment

CHAPTER 8

OFF-SITE TREATMENT AND RECYCLING

Several alternatives are available for off-site recycling or disposal of hazardous waste materials identified in this audit study. Those wastes have been categorized earlier in this report in Table 5-1. The wastes are specifically identified in Table 5-2 for both type and quantities. Waste exchange options per the California Waste Exchange are included.

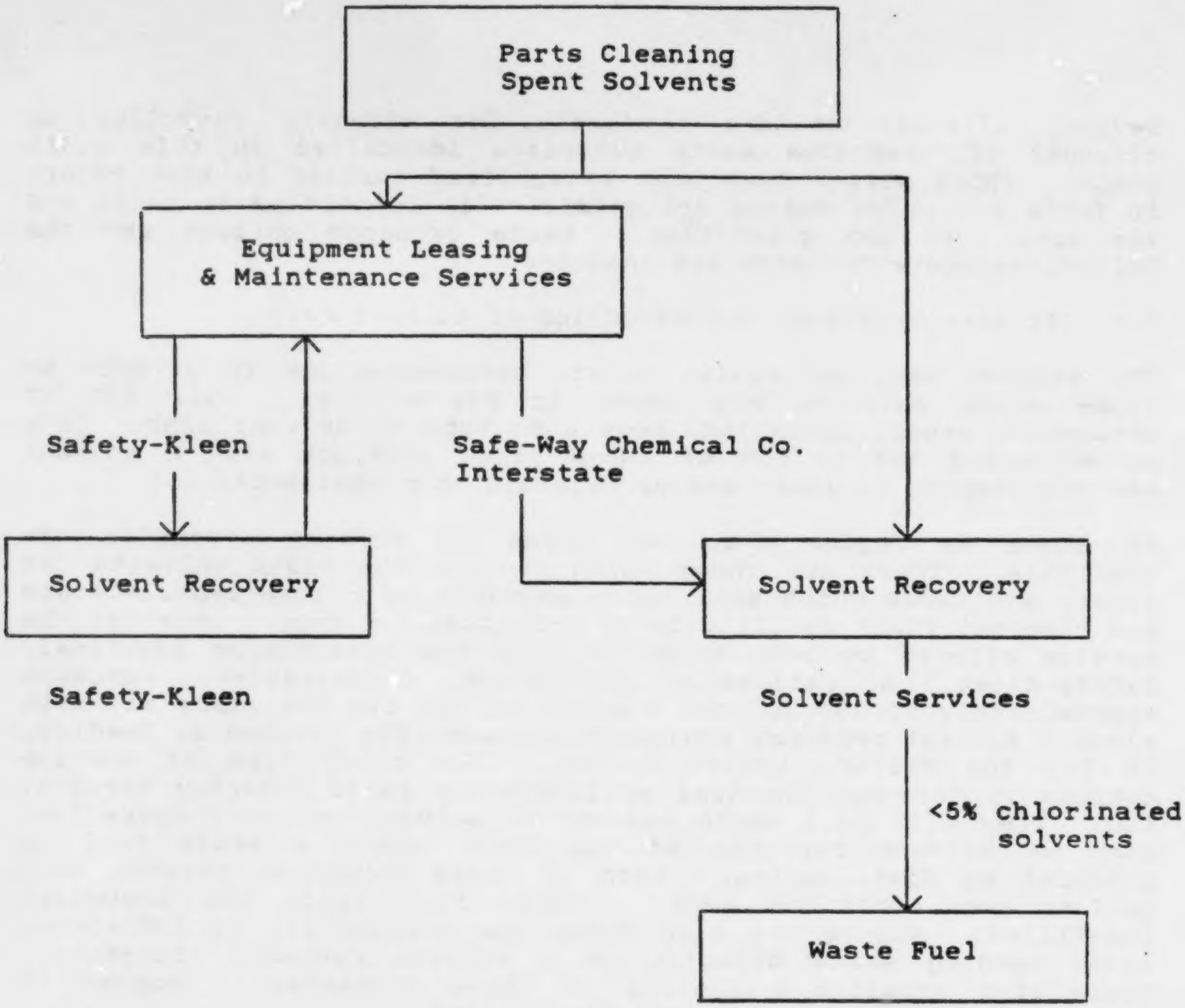
8.1 Off-Site Treatment and Recycling of Solvent Wastes

The methods many automotive repair businesses use to recycle or reuse waste solvents are shown in Figure 8-1. Over 95% of automotive repair operations have some type of solvent sink. Only an estimated 40% to 50% of these firms contract with a solvent service company to lease and/or maintain this equipment.

As shown in Figure 8-1, two types of service companies are available. There are those which process the waste solvents for reuse, and those which sell waste solvents to a Treatment, Storage and Disposal (TSD) facility to be processed for fuel. On-site, the service offered by both types of firm are essentially identical. Safety-Kleen, a nationally franchised organization, recovers approximately 10,000 gallons a month in the San Francisco Bay Area alone. Solvent recovery equipment is centrally located at Reedley, CA for the Western United States. The other type of service company is Safe-Way Chemical or Interstate Parts Cleaning Service, Inc. They will sell waste solvent to solvent recovery operations such as Solvent Services of San Jose, where a waste fuel is produced by distillation. Each of these companies recover 2000 gallons per month or more. Table 11-4 lists the companies identified. Figure 8-1 also shows the possibility of individual firms sending waste directly to a solvent recovery contractor. Table 11-2 provides a listing of those companies. Chapter 11 provides the economics for this alternative.

Figure 8-1

Off-Site Waste Solvent Recycling

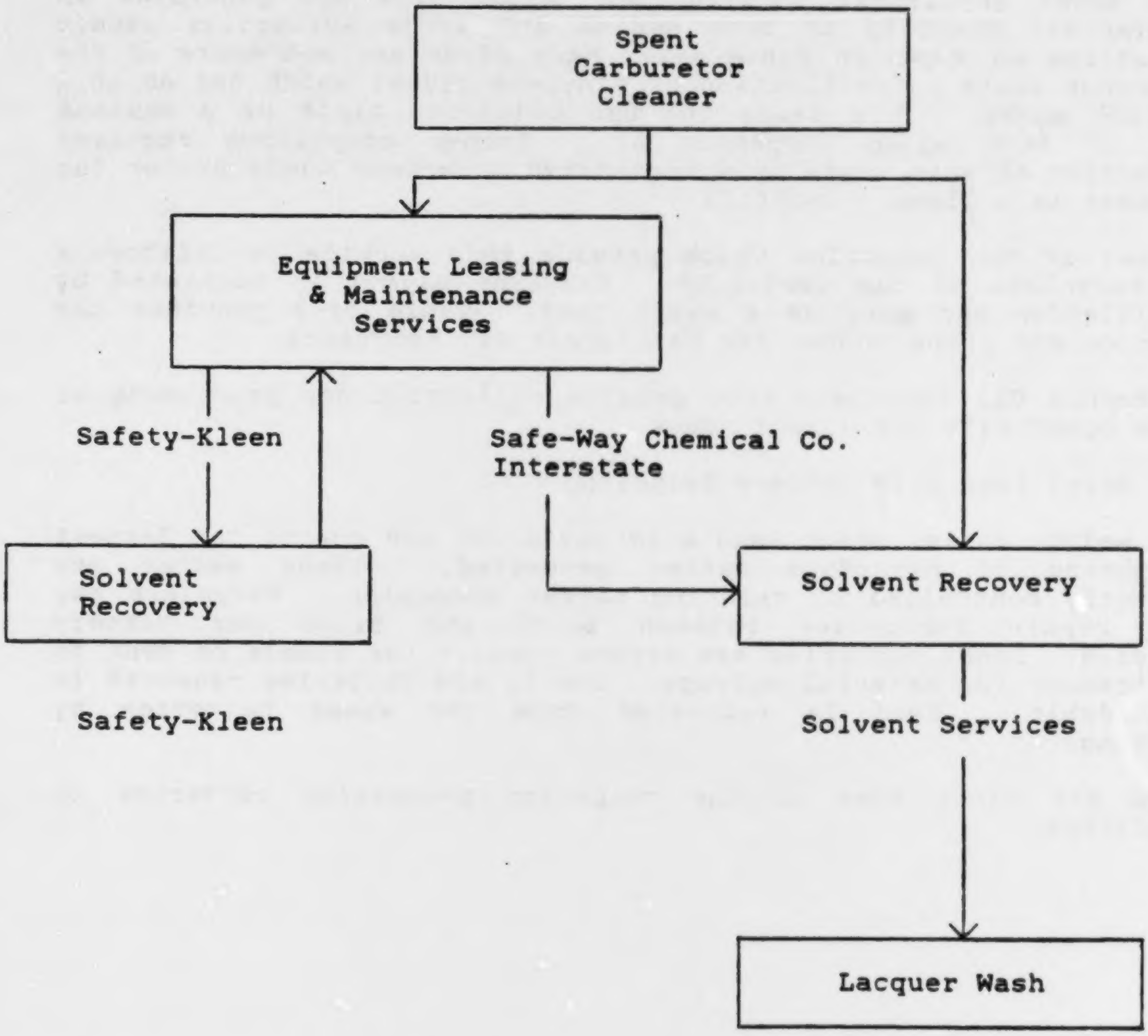

Parts Cleaning
Spent Solvents
Equipment Leasing
& Maintenance Services
Safety-Kleen
Safe-Way Chemical Co.
Interstate
Solvent Recovery
Solvent Recovery
Safety-Kleen
Solvent Services
<5% chlorinated
solvents
Waste Fuel

8.2 Off-Site Treatment and Recycling of Carburetor Cleaner

Smaller quantities of carburetor cleaner are used and generated for disposal. Typical automotive repair use at medium and larger operations were given in Table 5-2 for the firms audited. Figure 8-2 shows the recycling options.

Figure 8-2

Off-Site Waste Carburetor Cleaner Recycling


Spent Carburetor Cleaner
Equipment Leasing & Maintenance Services
Safety-Kleen
Safe-Way Chemical Co.
Interstate
Solvent Recovery
Solvent Recovery
Safety-Kleen
Solvent Services
Lacquer Wash

Carburetor cleaner can be recovered for reuse by distillation. This is practiced by Safety-Kleen at its Reedley CA facility. Service fees charged include pickup and disposal of spent solutions. Safe-Way Chemical and Interstate send the waste carburetor cleaner for solvent recovery at Solvent Services, Inc., where a lacquer wash is produced. Lacquer wash is used in paint stripping among other uses. Table 11-4 provides the addresses and phone numbers of the companies mentioned. Other companies which perform similar operations are given in Table 11-2.

8.3 Off-Site Treatment and Recycling of Spent Antifreeze Solution and Waste Motor Oils

Both spent antifreeze solution and motor oils are generated in substantial quantity at both medium and large automotive repair operations as shown in Table 5-2. Many firms are not aware of the hazardous waste classification of ethylene glycol which has an LD_{50} of 1400 mg/kg. This fails the DHS criterion limit of a maximum LD_{50} of 5000 mg/kg (Appendix 5). Proper compliance requires collection of this waste by a registered hazardous waste hauler for shipment to a Class 1 landfill.

Typical of the companies which provide this service is California Oil Recyclers of San Carlos,CA. Ethylene glycol is separated by distillation and used as a waste fuel. Table 11-3 provides the location and phone number for California Oil Recyclers.

California Oil Recyclers also provide collection and processing of waste motor oils for direct reuse.

8.4 Spent Lead-Acid Battery Recycling

On a weight basis, spent lead-acid batteries are one of the largest categories of hazardous wastes generated. These wastes are currently controlled by existing market economics. Recyclers pay auto repair businesses between $1.00 and $1.50 per battery recycled. Spent batteries are either rebuilt for resale or sent to a processor for material salvage. One in six batteries received is rebuildable. Lead is recovered from the spent batteries by smelting.

Table 8-1 lists some of the companies processing batteries in California.

Table 8-1

Battery Processors & Smelters

Service	Company	
Processing	Battery Exchange 2195 Story Rd. San Jose, CA 95122 (408) 251-3493	7000 lb./mo. processed
Smelting	GNB, Inc.- Metals Div. 2700 S.Indiana St. Los Angeles, CA 90023 (213) 262-1101 EPA ID No. CAD 097854541	9,000 lb.min. shipment
Smelting	RSR Quemetco, Inc. 720 S. 7th Ave. City of Industry, CA 91746 (800) 527-9452 EPA ID No. CAD 066233966	7,500 lb.min. shipment

PART II

SELF-AUDIT GUIDELINES

CHAPTER 9

INTRODUCTION

SELF AUDIT GUIDELINES

Part II provides a standard format. This is useful for individual repair shop owners or managers to perform a self-audit of their shops. The form is divided into two sections.

Chapter 10.1, General Characteristics, allows the operating characteristics of each shop or dealership to be identified. The material consumed and hazardous wastes generated are quantified. The equipment currently used on-site and current waste disposal methods are characterized. These wastes are then prioritized to determine the most hazardous streams and those streams which require the most immediate attention for waste control.

Chapter 10.2 provides guidelines to reduce the illegal sewering or off-site shipment of hazardous wastes. The three different approaches are: 1) General practice in handling of hazardous waste materials, 2) Source reduction by modifying the equipment or process used, and 3) Specific application of commercially available equipment and services to control hazardous wastes on-site or off-site. Chapter 10.2 also identifies the size of operations which benefit by the specific equipment or services.

Legal Criteria for Hazardous Wastes:

The criteria for hazardous waste determination are dictated by:

- State codes including Title 22 of the California Administrative Code which contains a list of materials rating the potential hazardous properties (toxicity, corrosivity, ignitability and reactivity) of each, and the criteria for identification of hazardous wastes.

- Local codes or ordinances limiting the heavy metal concentrations and oil and grease content for discharges to the sanitary sewer.

- Waste materials shipped off-site are identified on the waste manifest by hazard class. This is required by the Environmental Protection Agency (EPA), using the Department of Transportation (DOT) regulations.

- The manufacturer's Material Safety Data Sheet (MSDS) specifies the hazardous components of the fresh solvents and detergents used.

Regulating Off-Site Shipment of Hazardous Wastes:

Uniform Hazardous Waste Manifests per EPA Form 8700-22, DHS 8022A, are used when hazardous wastes are shipped off-site. The completion of this form is the responsibility of the waste generator. In certain situations licensed waste haulers are permitted to complete the form for the generator. This variation does not release the generator from the legal liability for proper disposition of this waste.

Code of Federal Regulations (CFR), Title 49 on Transportation, Subchapter C - Hazardous Materials Regulations provides the Federal rules for identification and transportation of hazardous materials. The names and classifications for shipment are provided by Title 49. Sections 10.1.6 and 10.1.9 of this standard format summarize the shipping name, classification and I.D. Number for the most commonly encountered raw materials and wastes generated.

CHAPTER 10

STANDARD FORMAT
WASTE AUDIT - AUTOMOTIVE REPAIRS

Section 10.1 - General Characteristics:

10.1.1 Identification

Company:______________________________ Date:________________
Site or Location:______________________________
Address:______________________________
Company Phone:______________________________
Site Manager:______________________________
Audit Personnel:______________________________

10.1.2 Type of Shop (check):

__ a. Automotive Repair Shop

- __ machine shop
- __ transmission repair
- __ brake/muffler shop
- __ radiator service
- __ alignment
- __ suspension & chassis
- __ scheduled maintenance
- __ ______________________

__ b. New Car Dealership

__ c. Diesel Engine Repair Shop

10.1.3 Size of Shop:

a. Cars Serviced per Week

- __ fewer than 10
- __ between 10 and 20
- __ between 21 and 40
- __ between 41 and 60
- __ between 61 and 100
- __ between 101 and 120
- __ more than 120

b. Number of Service Bays Available
(excluding wheel-alignment and painting bays)

- __ 1 to 4
- __ between 5 and 10
- __ between 11 and 15
- __ between 16 and 20
- __ between 21 and 25
- __ more than 25

10.1.4. Services Provided:
(# of cars serviced per week)

____ Scheduled Auto Maintenance
____ Transmission Maintenance
____ Engine Repair
____ Brake Service
____ Front End Alignment
____ Light Duty Repair, Noise covered by Warranties
____ Engine Tune-Up
____ Other____

10.1.5 Number of Shop Employees:___________

10.1.6 Raw Materials Used and Quantities Stored:

Complete the quantities for raw materials used. Densities (pounds per gallon) provided are to be used to calculate weights of materials used (pounds per month) by multiplying density by the quantity in gallons per month.

ITEM	RAW MATERIALS	GENERIC DESCRIPTION	HAZARD CLASS	UN/NA I.D.NO.	DENSITY LB/GAL (1)	STORAGE QUANTITY GAL	USAGE QUANTITY GAL/MO	USAGE QUANTITY LB/MO
1.	Parts Cleaning Solvent	Paraffin Solvent bp 310-370 deg.F	Combustible Liquid	UN 1255	6.5			
2.	Parts Washing Detergent	Alkaline Detergent	None	-	-			
3.	Parts Washing Compound	Caustic Soda & Srfctnts.	Corrosive Solid	UN 1759	-			
4.	Carburetor Cleaner	32% Methylene Chloride & 12% Cresylic Acid	Corrosive Material	NA 1760	9.0			
5.	Antifreeze Solution	Ethylene Glycol	Hazardous Liquid	NA 1142	9.3			
6.	Engine Oil	Petroleum Oil	Combustible Liquid	NA 1270	7.0			
7.	Sawdust Absorbant	Sawdust	None	None	-			
8.	Lead-Acid Batteries	Lead Dross (cont. >=3% free acid)	ORM-C	NA 1/94	35.0 lb.ea.			
	Other							
9.								
10.								
11.								
12.								

Note (1): Densities shown are typical of the waste description and can be used if specific material densities are not available.

10.1.7 Raw Materials Storage

Complete a separate sheet for each item identified in Section 10.1.6.

Raw Material ______________________________

Item Number ______________

a. Describe how this material is used:

b. Storage container:

____ 55 gallon drum ____ Containers (specify volume)_____

____ Aboveground tank ____ Underground tank

Are tight-fitting lids provided on drums? _____

Are bung holes sealed or fitted with tight valves? _____

c. Storage Area:

____ Indoors ____ Covered ____ Concrete ____ Locked

____ Outdoors ____ Uncovered ____ Asphalt ____ Unlocked

____ Dirt

d. Delivery System:

____ Gravity Spigot ____ Pump ____ Funnel

____ Other __________________________

e. How is material usage controlled?:

____ Stockroom attendant
____ Access limited to designated personnel
____ Sign-out sheet
____ Materials readily accessible to all personnel

10.1.8. Equipment Used On-Site or Operations Generating Hazardo Waste:

Automotive Parts Cleaning indicate number used on-site

Solvent Sinks: ___ small (1-6), ___ large (7 or more)

Jet Spray Washer: ___ small (1), ___ large (2 or more)

Carburetor Cleaner: ___ small (1), ___ large (2 or more)
Agitators

Dunk Buckets:

Solvent: ___ small (1), ___ large (2 or more)
Carburetor Cleaner: ___ small (1), ___ large (2 or more)

Other Equipment:

____________________: ___

____________________: ___

Engine Cleaning

Hot Tank- Detergent: ___ small (1), ___ large (2 or more)
- Caustic: ___ small (1), ___ large (2 or more)

Spray Cleaning: ___ small (1), ___ large (2 or more)

Engine Maintenance

	Waste Generated On-Site? Yes/No
Spent Antifreeze Solution:	________
Engine Oil:	________
Spent Automotive Battery:	________
Oily Rags:	________
Spent Transmission Fluid:	________

10.1.9 Waste Materials Generated:

a. Complete the quantities for waste materials generated. Densities provided are to be used to calculate weights of materials generated.

ITEM	WASTE GENERATED	DOT SHIPPING NAME	HAZARD CLASS	UN/NA I.D.NO.	DENSITY LB/GAL (1)	STORAGE QUANTITY GAL	USAGE QUANTITY GAL/MO	USAGE QUANTITY LB/MO
1.	Spent Solvent	Waste Petroleum Dist.	Combustible Liquid	UN 1255	7.7	______	______	______
2.	Aqueous Detergent Waste	Waste Corr.Liquid,N.O.S.	Corrosive Liquid	UN 1760	8.4	______	______	______
3.	Aq.Caustic Detergent Waste	Waste Corr.Liquid,N.O.S.	Corrosive Liquid	UN 1760	8.4	______	______	______
4.	Carburetor Cleaner	Waste Cpd.Clng.Liquid	Corrosive Liquid	NA 1760	9.8	______	______	______
5.	Spent Antifreeze Solution	Waste Liquid	ORM-E	UN 9189	8.8	______	______	______
6.	Waste Engine Oil	Waste Petroleum Oil	Combustible Liquid	NA 1270	7.0	______	______	______
7.	Spent Sawdust	Waste Corr.Solid N.O.S.	Hazardous Solid	UN 1759	-			______
8.	Lead-Acid Batteries	Lead Dross(Containing >=3% free acid)	ORM-C	NA 1/94	35.0 lb.ea.			______
9.	Detergent for Floor Wash	Waste Corrosive Liquid	Corrosive Liquid N.O.S.	UN 1760	8.4	______	______	______
10.	Steam-Out Waste Sump	Waste Corr.Solid N.O.S.	Corrosive Solid	UN 1759	varies			______
11.	Waste Fuel	Waste Petroleum Dist.	Combustible Liquid	UN 1255	7.7	______	______	______
	Other							
12.	______	______	______	______	______	______	______	______
13.	______	______	______	______	______	______	______	______

Note (1): Densities shown are typical of the waste description and can be used if specific material densities are not available.

b. Are wastes segregated from each other? ________

If not, what wastes are combined and estimate the combined rate of generation:

What options are available to facilitate waste segregation?

10.1.10 Waste Material Storage

Complete a separate sheet for each item identified in Section 10.1.9:

Waste Material ____

Item Number ______________________

a. Waste Storage.

(1) Type of container used to store waste.

	Volume (Gallons)
____ Drum	____________________
____ Sump	____________________
____ Undergroumd tank	____________________
____ Aboveground tank	____________________
____ Refuse dumpster	____________________
____ Other	____________________

(2) How/where is waste stored?

____ Indoors	____ Covered	____ Concrete	____ Locked
____ Outdoors	____ Uncovered	____ Asphalt	____ Unlocked
		____ Dirt	

b. Waste Removal.

(1) Waste removal alternatives

____ Private waste hauler
____ Recycler/reclaimer
____ Public refuse collection system
____ Other __________________________

(2) How does hauler remove wastes?

____ Pump truck
____ Removal/replacement of container
____ Other ___________________________

(3) How often are wastes removed? (No. of days) ____________

(4) Are manifests received from hauler for off-site disposal?
____

10.1.11 Current Waste Management Practices

Method

A — On-Site Recycling
B — Off-Site Treatment & Recycling
C — Service by Equip.Lease & Maintenance contractor:
D — Waste picked up by Waste Service contractor
E — Disposal in Municipal Solid Waste*
F — Disposal in Municipal Sewer*

(check one or more)

<--- Preferred Response
Less Desirable Response--->

Waste Material	A	B	C	D	E	F	Other
Waste Solvent:							
Aq. Detergent Waste:							
Aq. Caustic Waste:							
Waste Carburetor Cleaner:							
Waste Antifreeze Soln:							
Waste Engine Oil:							
Waste Sawdust:							
Spent Lead-Acid Batteries:							
Waste Detergent Floor Wash:							
Waste Oily Rags:							
Waste from Steam-Out Sump:							
Waste Fuel:							

* These practices may be illegal.

10.1.12 Material Losses:

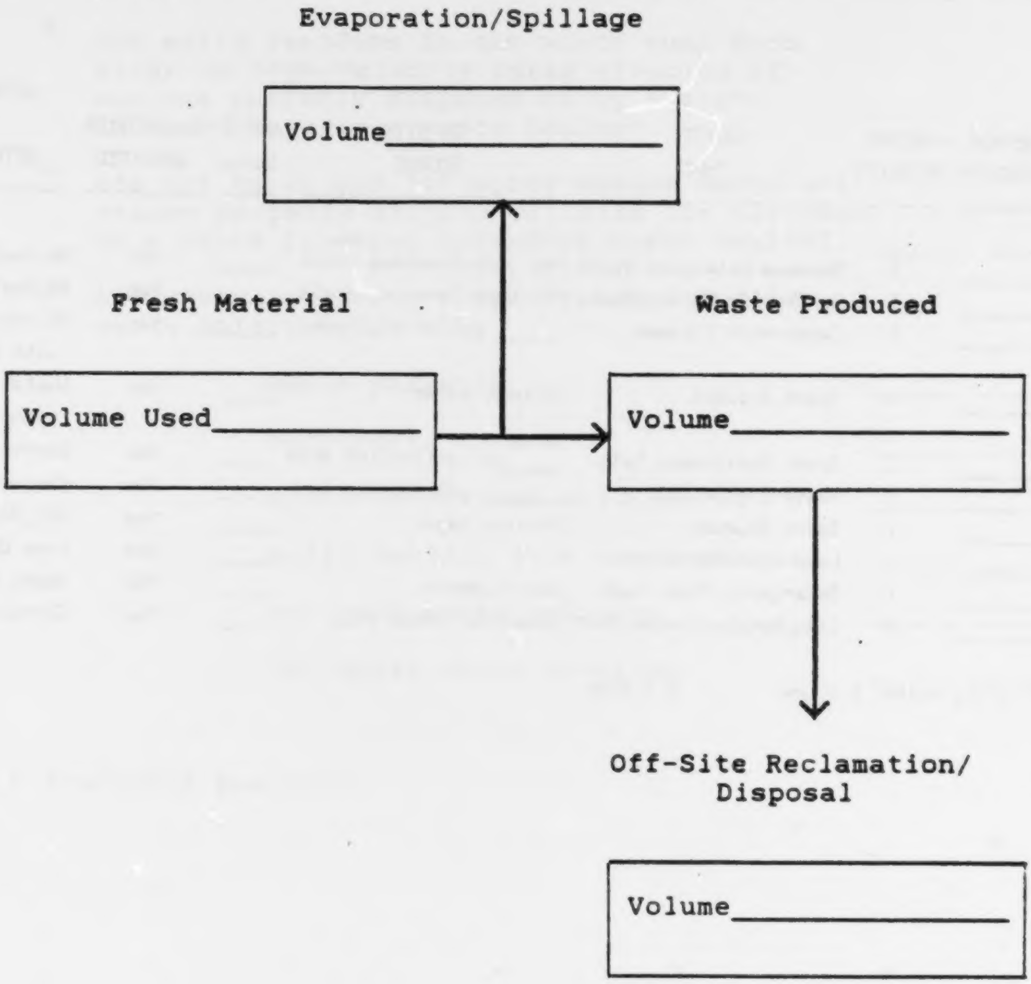
Material	Quantity		Losses Due To
	gal/mo	lb/mo	
Parts Cleaning Solvent			Evapn. & Spillage
Grease & Oil			To storm sewer from paving.
Other Losses:			

10.1.13 Provide a waste stream schematic with a material balance. Complete a separate sheet for each item identified in Section 10.1.9.

Waste Material ______________________________________

Item Number ___________________

Type of Process:


Evaporation/Spillage
Volume______________
Fresh Material
Volume Used__________
Waste Produced
Volume______________
Off-Site Reclamation/ Disposal
Volume______________

10.1.14 Prioritized Sites of Significant Waste Generation:

This item identifies hazardous wastes produced on-site. The repair service owner or manager decides which waste materials warrant immediate attention.

The hazard priority is assigned based upon disposal and toxicity of the contaminants present. The action priority should be assigned by the audit personnel based upon whether the high priority hazardous wastes are controlled by proper disposal methods. Improper control of a high priority hazardous waste would require a high action priority.

ACTION PRIORITY	HAZARD PRIORITY	WASTE TYPE	ON-SITE SOURCE	WASTE lb/mo	MANIFESTING REQUIRED	CRITERIA FOR WASTE DETERMINATION
_______	5	Aqueous Detergent Waste	Hot tank-Aluminum metal	____	Yes	Aq.Waste w.Metals
_______	5	Aq.Caustic Deterg.Waste	Hot tank-Ferrous metals	____	Yes	Aq.Waste w.Metals
_______	5	Carburetor Cleaner	_____ gallon dip tank	____	Yes	Chlorinated Solvent with Metals
_______	4	Spent Solvent	Solvent sinks	____	Yes	Waste Solvent with Metals
_______	2	Spent Antifreeze Soln.	___ gal.collection drum	____	Yes	Corrosive Material
_______	2	Waste Engine Oil	______ gal.storage tank	____	Yes	Combustible Liquid
_______	1	Spent Sawdust	Service bays	____	Yes	Oil,Grease & Metals
_______	1	Lead-Acid Batteries		____	Yes	Lead Dross
_______	1	Detergent, Floor Wash	Wash buckets	____	Yes	Waste Liquid w.Oil
_______	5	Oily,Metals-Contam.Dirt	Steam-out waste sump	____	Yes	Corrosive Solids

Priority scale: 1 = Low 5 = High

Section 10.2 Waste Management Options

10.2.1 General Practice:	YES*	NO
o Are waste solvents and carburetor cleaners properly isolated and collected for disposal to avoid contamination of waste engine oils?	_____	_____
o Are waste motor oils properly accumulated for off-site shipment?	_____	_____
o Is spent antifreeze solution being properly disposed of by a waste management service?	_____	_____
o Are solid residues in the waste sump from steam or high-velocity spray cleaning of engines properly disposed of by a state licensed hazardous waste hauler?	_____	_____
o Are hot tanks and jet spray washer waste solutions properly shipped off-site for disposal by a state licensed hazardous waste hauler?	_____	_____
o Are waste manifests properly completed for waste materials?		
waste solvents	_____	_____
carburetor cleaner	_____	_____
spent antifreeze solution	_____	_____
solid residue from waste sump	_____	_____
hot tank waste solution	_____	_____
jet spray waste solution	_____	_____

* Preferred Response

10.2.2 Source Reduction

Have the following source reduction options been evaluated and implemented to minimize waste generation?	evaluated yes/no	implemented yes/no
o Product Reformulation		
Elimination of 1,1,1 trichloroethane from carburetor cleaner solutions		
o Safe Substitution		
Use of detergent based compounds in place of caustic based compounds for hot tank or jet spray solutions		
o Plant Modernization		
Use of solvent sinks for parts washing on an owned or leased basis to improve solvent reuse and waste containment		
o Improvement in Operating Practice to Minimize Losses		
Addition of drip trays:		
to solvent sinks		
to hot tanks		
o Two Stage Parts Cleaning Using Hot Tanks or Jet Spray Washers (For large auto repair operations a two stage parts cleaning would yield clean parts over a longer period between solution changeouts or recharge.)		
o Filtration of Solids in Jet Spray Operation to Extend Solution Life		

10.2.3 Specific Waste Management Options

Five levels of solvent and aqueous hazardous waste controls are outlined below. Guidelines identify current management practices and existing technology commercially available to improve hazardous waste controls.

Level 1. No control - once-through waste generation and disposal to municipal sewer or dumpster.

Level 2. Waste collection for proper disposal.

Level 3. On-site reuse/recycle equipment to minimize solution use or loss.

Level 4. Service company to provide off-site waste recovery or recycling.

Level 5. On-site waste reclaim equipment.

Level 6. Source reduction.

10.2.3 Selection of Waste Management Options

A) Waste Treatable On-Site

For each waste source listed in the first column of the table below identify costs or typical payback times to install waste minimization equipment.

- o Begin by identifying the current level of waste control and enter that level in the second column.

Waste Management Control Level

Level 1. No control - once-through waste generation and disposal to municipal sewer or dumpster.
Level 2. Waste collection for proper disposal.
Level 3. On-site reuse/recycle equipment to minimize solution use or loss.
Level 4. Service company to provide off-site waste recovery or recycling.
Level 5. On-site waste reclaim equipment.
Level 6. Source Reduction.

- o Determine cost to upgrade to improved levels of waste control in Section 10.2.4 using typical or actual costs developed in Section 10.2.3B.
- o Select the most suitable option developed in Sectiion 10.2.4 and fill in Column 3.

COLUMN 1 WASTE SOURCE	COLUMN 2 CURRENT LEVEL OF WASTE CONTROL	COLUMN 3 FUTURE LEVEL OF WASTE CONTROL
Solvent Parts Washer		
Jet Spray Parts Washer		
Hot Tank		

B) Waste Treatable On-Site - Costs

- o For each waste source listed in the table below identify costs or typical payback times to improve waste minimization.
- o Use these costs to complete the table in section 10.2.4 for each applicable control level.

Waste Management Control Level

Level 1. No control - once-through waste generation and disposal to municipal sewer or dumpster.
Level 2. Waste collection for proper disposal.
Level 3. On-site reuse/recycle equipment to minimize solution use or loss.
Level 4. Service company to provide off-site waste recovery or recycling.
Level 5. On-site waste reclaim equipment.
Level 6. Source Reduction.

	WASTE MANAGEMENT CONTROL LEVEL							
	LEVEL 2 WASTE HAULING		LEVEL 3 EQUIPMENT		LEVEL 4 SERVICE		LEVEL 5 ON-SITE WASTE RECLAIM EQUIPMENT PAYBACK TIME (2)	
WASTE SOURCE	ACTUAL COST	TYPICAL COST (1)	ACTUAL COST	TYPICAL COST (1)	ACTUAL COST	TYPICAL COST (1)	TYPE OF FIRM	INSTALLED COST
	(55 gallons)		(Each Unit)		(Each Service Call)			
Solvent Parts Washer	________	$130-$325	________	$200-$400	________	$34 - $38	Repair Shop/Dealership Equip.Lease & Maint.Firm	uneconomical 3 to 6 yr.payback
Jet Spray Parts Washer	________	$357	________	$3400-$4500	________	$242	Repair Shop/Dealership Equip.Lease & Maint.Firm	3 to 4 months 2 to 19 months
Hot Tank	________	$357	________	$300	________	$93	Repair Shop/Dealership Equip.Lease & Maint.Firm	3 to 4 months 2 to 19 months
Reference Section: Economic (3) Technical		11.2		11.1		11.2 13.1		11.3 12.1

Note 1. Costs shown are typical. Actual costs should be developed for each application.

Note 2. Payback time calculations are typical. Specific analysis requires more complex calculations. Individual case studies are given in Sections 11.3, 12.1, and Appendix 3.

Note 3. Sections referenced in this report which provide typical costs and payback times.

C) Waste Requiring Off-Site Treatment or Disposal

For each waste source listed in the first column of the table below identify costs to provide waste hauling or off-site waste recovery.

- o Begin by identifying the current level of waste control and entering that level in Column 2. (Levels 3 & 5 are not applicable to these wastes))

Waste Management Control Level

Level 1. No control - once-through waste generation and disposal to municipal sewer or dumpster.
Level 2. Waste collection for proper disposal.
Level 4. Service company to provide off-site waste recovery or recycling.
Level 6. Source Reduction.

- o Determine cost to upgrade to improved levels of waste control in Section 10.2.4, using typical or actual costs developed in Section 10.2.30.
- o Select the most suitable option developed in Section 10.2.4 and fill in Column 3.

COLUMN 1 WASTE SOURCE	COLUMN 2 CURRENT LEVEL OF WASTE CONTROL (fill in)	COLUMN 3 LEVEL OF WASTE CONTROL TO BE INSTALLED
Waste Carburetor Cleaner	_________	_________
Waste Antifreeze Solution	_________	_________
Waste Engine Oil	_________	_________
Spent Sawdust Absorbant	_________	_________
Spent Lead - Acid Batteries	_________	_________
Waste Oily Rags	_________	_________
Waste from Steam-Out Sump	_________	_________

D) Waste Requiring Off-Site Treatment or Disposal - Costs

- o Use the table below to list or provide typical costs to provide waste hauling or off-site waste recovery.

Waste Management Control Level

Level 1. No control - once-through waste generation and disposal to municipal sewer or dumpster.
Level 2. Waste collection for proper disposal.
Level 4. Service company to provide off-site waste recovery or recycling.
Level 6. Source Reduction.

- o Determine cost recovery or payback period to upgrade to improved levels of waste control. (see Section 10.2.4)
- o Select the most suitable upgrade option to implement.

	WASTE MANAGEMENT CONTROL LEVEL			
	LEVEL 2 WASTE HAULING		LEVEL 4 SERVICE	
WASTE SOURCE	ACTUAL COST	TYPICAL COST(1)	ACTUAL COST	TYPICAL COST(1)
	(55 Gallons)		(Each Service Call)	
Waste Carburetor Cleaner	__________	$357	__________	$60
Waste Antifreeze Solution	__________	$234	__________	-
Waste Engine Oil	__________	$40 per pick-up	__________	-
Spent Sawdust Absorbant	__________	-	__________	-
Spent Lead - Acid Batteries	__________	$1 credit per battery	__________	-
Waste Oily Rags	__________	-	__________	-
Waste from Steam-Out Sump	__________	-	__________	-
Reference Section: Economic (2)		11.2		-

Note 1. Costs shown are typical. Specific analysis requires more complex calculations.
Note 2. Sections referenced in this report which provide typical costs and payback times.

Example 1:

Consider changing from a shop owned and maintained solvent sink to a leased solvent sink.

Basis: 1 solvent sink, 7 gallons spent solvent per month to disposal and 10 gallons of fresh solvent makeup.

The analysis would look like this:

CONTROL LEVEL:			CURRENT 3	FUTURE 4			
	RATE	BASIS	CURRENT COSTS $/month	FUTURE COSTS $/month	CURRENT COSTS MINUS FUTURE COSTS = SAVINGS $/month	EQUIPMENT CAPITAL COST $	CAPITAL COST DIVIDED BY SAVINGS = PAYBACK TIMES months
Labor Costs:	$38/mh	3 man hrs.	$114	$0			
Material Costs:	$100/55gal	7 gallons	$13	$0			
Disposal Costs:	$200/55gal	10 gallons	$36	$0			
Leasing Costs:	$		$0	$36			
Total:			$163	$36	$127		

Example 2:

Consider installing a jet-spray washer in place of leased equipment

Basis: 10 gallons spent waste each month to disposal.

CONTROL LEVEL:			CURRENT 4	FUTURE 3			
	RATE	BASIS	CURRENT COSTS $/month	FUTURE COSTS $/month	CURRENT COSTS MINUS FUTURE COSTS = SAVINGS $/month	EQUIPMENT CAPITAL COST $	CAPITAL COST DIVIDED BY SAVINGS = PAYBACK TIME months
Labor Costs:	$38/mh	3 man hrs.	$0	$114			
Material Costs:	$1.50/lb	10 lbs.	$0	$15			
Disposal Costs:	$200/55gal	10 gallons	$0	$36			
Leasing Costs:	$242/month		$242	$0			
Total:			$242	$165	$77	$3,700	48

CHAPTER 11

WASTE TREATMENT AND RECYCLING ECONOMICS

This section on automotive repair waste management costs will be presented by categorizing the methods of control by three of the five levels of control identified in Section 10.2.

Level 3 - On site reuse/recycle equipment to minimize solution use or loss.

Level 4 - Service company to provide off-site waste recovery and recycling.

Level 5 - On-site waste reclamation equipment

The specifics on the economic optimum level of operation recommended was developed in Chapters 12 and 13. This section will summarize the costs and payback periods used to arrive at those conclusions.

11.1 Purchase Costs for On-Site Reuse/Recycle Equipment

Equipment	Size	Cost (Approx.)
Solvent Parts Washer	sm.,fill/capacity 11/22gal or 10/16gal	$200 - $300
	lg.,fill/capacity 15/30gal or 20/30gal	$250 - $400
Jet Spray Washer	45 gal	$3,400
	85 gal	$3,800
	100 gal	$4,500
Hot Tank	60 gal	$300

Cost Data: November, 1986

Table 11-1 provides sources for this equipment.

Table 11-1

Manufacturers of On-Site Reuse/Recycle Equipment
(Partial List)

Item	Supplier	Telephone
Solvent Parts Washer	SDI Co. P.O. Box 835 Upland. CA 91785	(714) 982-0553
	distributed through:	
	JJS Warehouse, Inc. 1076 Park Ave. San Jose, CA	(408) 294-9717
	or:	
	Quaker State Oil Distributor Carson Branch - Los Angeles	
Jet Spray Washer	Equipment Manufacturing Corp. 1433 Lidcombe Ave. South El Monte, CA 91733	(818) 575-1644
Hot Tank	Equipment Manufacturing Corp. 1433 Lidcombe Ave. South El Monte, CA 91733	(818) 575-1644

Appendix 7 shows examples of Solvent Parts Washers, Hot Tanks, and the Pressure Cleaning Chambers (Jet Spray Washers) respectively.

11.2 Costs to Provide Off-Site Waste Recovery and Recycling

Hazardous waste recyclers or haulers are licensed by the State of California. They have permits to ship and manifest only specific hazardous waste materials. Equipment Leasing and Maintenance Services are also waste haulers licensed by the State of California for specific hazardous material. These firms also lease equipment and provide on-site maintenance services.

11.2.1 Hazardous Waste Recyclers and Haulers

HAZARDOUS WASTE TYPE						HAZARDOUS WASTE RECYCLER OR WASTE HAULER	COSTS
SPENT SOLVENT	AQ.DETGNT. OR ALKALI WASTES	SPENT ANTIFREEZE SOLUTIONS	WASTE ENGINE OILS	CARB. CLEANER	LEAD ACID BATTERIES		
						SOLVENT SERVICE, INC. (1)	
x						$0.15 Credit for >2000 gal.	$130/55 gal.
	x			x		$70.00 for 5 gal.drop off	$357/55 gal.
						CALIFORNIA OIL RECYCLERS	
		x				$72.50 per hr.,3hr.min +$0.30/gal.	$234/55 gal.
			x			flat fee per pickup	$40
x		x		x		ZERO WASTE	$325 min.fee per 55 gal.
					x	BATTERY EXCHANGE	$1.00 credit per battery

Cost Data: November, 1986

(1) Solvent Services will pay $0.15 per gallon for pick-ups by its tank truck in quantities greater than 2000 gallons. If 5 gallons or less are dropped off at its treatment facility, a $70 disposal fee is charged.

These companies represent the types of services available and typical costs. Table 11-2 and Table 11-3 provide other sources for this service.

Table 11-2
Spent Solvent Recycling Firms

Solv. Sinks	Carb. Clnr.	Company	Address	Telephone
	x	Baron-Blakeslee, Inc. Service: Hauler, Processor, Seller	3596 California St. San Diego, CA 92101 EPA ID No.: CAT 000618652	(619) 295-0041
	x	Baron-Blakeslee, Inc. Service: Hauler, Processor, Seller	8333 Enterprise Dr. Newark, CA 94560 EPA ID No.: CAD 074644659	(415) 794-6511
	x	Bayday Chemical Service: Hauler, Processor	2096-B Walsh Ave. Santa Clara, CA 95050 EPA ID No.: CAT 080012263	(408) 727-8634
	x	Detrex Chemical Industries Inc. Service: Hauler, Processor	3027 Fruitland Ave. Los Angeles, CA 90058 EPA ID No.: CAD 020161642	(213) 588-9214
x	x	Oil and Solvent Process Company Service: Hauler, Processor, Seller	1704 West First St. Azusa, CA 91702 EPA ID No.: CAD 008302903	(818) 334-5117
x	x	Omega Recovery Svcs. Service: Hauler, Processor, Seller	12504 E.Whittier Blvd. Whittier, CA 90602 EPA ID No.: CAD 042245001	(213) 698-0991
x	x	Romic Chemical Corp. Service: Hauler, Processor	2081 Bay Road East Palo Alto, CA 94303 EPA ID No.: CAD 009452657	(415) 324-1638
x	x	Solvent Services Service: Hauler, Processor	1021 Berryessa Rd. San Jose, CA 95133 EPA ID No.: CAD 059494310	(408) 286-6446

Table 11-3

Spent Antifreeze and Waste Engine Oil Recycling

Anti-Freeze	Waste Oil	Company	Address	Telephone
x	x	California Oil Recyclers, Inc. Service: Processor	977 Bransten Rd. San Carlos, CA 94070 EPA ID No: CAD 980695761	(415) 591-2603
	x	Demenno/Kerdoon Service: Processor	2000 North Alameda St. Compton, CA 90222 EPA ID No.: CAT 080013352	(213) 537-1000
	x	Fuel Processors, Inc. Service: Rerefiner	P.O. Box 1407 Woodland, WA 98674	(503) 286-8352
	x	Hedrick Distrib. Inc. Serv.: Hauler, Storage	210 Encinal St. Santa Cruz, CA 95060 EPA ID No.: CAD 088838222	(408) 427-3773
	x	Industrial Oils, Inc. Service: Rerefiner	P.O. Box 1221 Klamath Falls, OR 97601	(503) 884-4685
	x	Lubrication Co. of Am. Service: Hauler, Processor	4212 East Pacific Way Los Angeles, CA 90223 EPA ID No.: CAD 008247629	(213) 264-1091
	x	Nelco Oil Refining Corporation Service: Processor	600 West 12th St. National City, CA 92050 EPA ID No.: CAD 008352890	(619) 474-7511
x	x	Pepper Oil Co., Inc. Service: Processor	2300 Tidelands Ave. National City, CA 92050 EPA ID No.: CAT 000613547	(619) 477-9336
x	x	Triad Marine & Indust. Cleaning Corp. Service: Processor	1668 National Ave. San Diego, CA 92113 EPA ID No.: CAD 098240062	(619) 239-2024
x	x	Triple J Pacification Service: Processor	3650 East 26th St. Vernon, CA 90023 EPA ID No.: CAT 080033681	(213) 268-5056

11.2.2 Equipment Leasing and Maintenance Services

1. Solvent Sinks - includes the following services
   - o Monthly leasing of a solvent sink with recirculation pump
   - o Monthly general maintenance service with removal of spent solvent and replacement with fresh solvent

COMPANY	EQUIPMENT SIZE	COST PER MO. (APPROX)
Safe-Way Chemical Co.	11 gal.solvent/22 gal barrel	$38.00
Interstate Parts Cleaning Service, Inc.	10 gal.solvent/16 gal barrel	$33.75
Safety Kleen Corp.	10 gal.solvent/16 gal barrel	$36.75

Cost Data: November, 1986

2. Hot Tanks - includes the following services
   - o Monthly leasing of a hot tank
   - o Monthly general maintenance service with removal of 10 gallons of solution and sludge and recharge of solution with caustic or alkaline detergent and makeup water.

COMPANY	EQUIPMENT SIZE	COST PER MO. (APPROX)
Safe-Way Chemical Co.	60 gallon	$ 93.00

Cost Data: November, 1986

3. Jet Spray Washers - includes the following services
   - o Monthly leasing of a jet spray
   - o Monthly general maintenance service with removal of 10 gallons of solution and sludge and recharge of solution with caustic or alkaline detergent and makeup water.

COMPANY	EQUIPMENT SIZE	COST PER MO. (APPROX)
Safe-Way Chemical Co.	90 gallon	$ 242.00

Cost Data: November, 1986

Table 11-4 provides the addresses and phone numbers for the leasing and service companies in this category.

Table 11-4

Equipment Leasing and Service Companies
-Solvent Parts Washers
-Carburetor Cleaners

Company	Address	Telephone
Safety-Kleen Corp.	1147 N. 10th Street San Jose, CA 95112	(408) 294-8778
Safe-Way Chemical Co.	909 Stockton Ave. San Jose CA 95110	(408) 292-9289
Interstate Parts Cleaning Service, Inc.	628 Emory Street San Jose, CA 95110	(408) 255-2300

11.3 Costs and Payback Periods on Investment for Equipment and Processes for On-Site Recycling

This section summarizes the economic results presented in Chapter 12. Appendix 3 provides the specific case studies upon which the results are based. The Lotus 1-2-3^{TM} computer template is given in Appendix 3.

11.2.1 Solvent Recovery Equipment - Payback Periods and Cost Savings

	EQUIPMENT CAPACITY		
FIRM SIZE	10-15 GAL PER 8 HR. MODEL R-2,LS-15	48 GAL PER 8 HR. MODEL RS-20	80 GAL PER 8 HR. MODEL RS-35AF
		(See Table 7-1)	
Small/medium repair operation 10 gal/mo,$20/hr.labor	<Negative Payback Economics>		
Large Dealership			
70 gal/mo,$38/hr.labor	<Negative Payback Economics>		
70 gal/mo,$8.40/hr.labor	8 to 9 yrs ($800-$1400 per year savings)	23 yrs. ($1200 per year savings)	25 yrs. ($1400 per year savings)
Equipment lease and maint. service, 2200 gal/mo,$11/hr.labor	-	-	6 yrs. ($4,800 per year savings)
3800 gal/mo,$11/hr.labor	-	-	3 yrs. ($9,200 per year savings)

Cost Data: November, 1986

Table 7-1 provides the equipment characteristics and names and addresses for the companies in this category.

Table 7-1*

SOLVENT RECOVERY EQUIPMENT SUPPLIERS
AND
EQUIPMENT CHARACTERISTICS

Supplier	Model	Equipment Capacity	Cost	Temp. Limit (°F)
Recyclene Products, Inc.	R-2	5 gal./4 hr.	$2,495	<375°
405 Eccles Ave.	RS-20	5-7 gph (1)	$11,000	<375°
So.San Francisco, CA 94080	RS-35AF	6-8 gph (2)	$21,000	<375°
(415) 589-9600	RX-35AF	12-16 gph (2)	$25,850	<375°
Solvent Distillation Equip.	LS-Jr.	5 gal./8 hr.	$2,995	<320°
Finish Engineering Company	LS-15	15 gal./8 hr.	$5,895	<320°
921 Greengarden Rd.	LS-15V	15 gal./8 hr.	$9,390	<500°
Erie, PA 16501				
(814) 455-4478				
(415) 821-4154				

Notes: (1) 4 hours per cycle
(2) Continuous operation

* Repeated from page 23

11.3.2 Aqueous Waste Volume Reduction Equipment Payback Periods and Annual Cost Savings

	EQUIPMENT CAPACITY			
FIRM SIZE	2 x 85 gal per 22 hr. Model 85-E	150 gal per 15 hr. Model FE-150	50 gal per 8 hr. Model BM-50	200 gal per 8 hr. Model BM-200
Small/medium repair operation 90 gal/mo,$20/hr.labor Notes 1 & 2	3 yrs. ($840/yr. savings)	<Negative Payback Economics>		
Large Dealership 20 gal/mo,$38/hr.labor Notes 1 & 2	4 yrs. ($840/yr. savings)	<Negative Payback Economics>		
Equipment lease and maint.service 5000 gal/mo, $11/hr.labor Note 2	2 mo. ($28,000 per year savings)	3 mo. ($41,500 per year savings)	19 mo. ($31,300 per year savings)	12 mo. ($49.000 per year savings)

Cost Data: November, 1986

Notes: 1. Payback based upon leased parts washer
2. Waste solids disposal costs at $115 per drum

Table 11-5 provides the equipment characteristics and names and addresses for companies in the previous table.

TABLE 11-5

AQUEOUS WASTE VOLUME REDUCTION SUPPLIERS AND EQUIPMENT CHARACTERISTICS

Supplier	Model	Equipment Capacity	Cost
D & K Sales 1433 Lidcombe Ave. So.El Monte, CA 91733 (818) 575-1644	EVAP-85E	85 gallons	$1,995
Nordale Fluid Eliminator 990 Xylite Ave., N.E. Minneapolis, MN 55434 (603) 668-7111 (714) 855-0691	FE-150	150 gallons	$8,000 to $13,000
Wastewater Treatment Systems 440 N. Central Ave. Campbell, CA 95008 (408) 374-3030	BM-50	50 gallons	$15,000 to $18,000

Cost Data: November, 1986

CHAPTER 12

ON-SITE RECYCLING, RESOURCE RECOVERY AND TREATMENT

This section will describe the alternatives for on-site recycling and resource recovery. These will be presented in two major areas:

- Equipment and processes for on-site recycling
- Management practices to aid recycling and resource recovery

The most appropriate and economic level of application of each treatment and recycling alternative is developed in Chapter 11.

12.1 Equipment and Processes

This category applies to the solvent and aqueous parts cleaning solutions identified in Section 10.1.9. The processes evaluated are solvent recovery by distillation and aqueous waste volume reduction by evaporation and concentration of sludges. Additionally, filtration extends the life of aqueous wash solutions by removing hazardous solids.

12.1.1 Solvent Waste Recycling

Table 12-1 identifies the equipment evaluated. Both of these manufacturers supply a range of equipment sizes.

Table 12-1
SOLVENT RECOVERY EQUIPMENT SUPPLIERS AND EQUIPMENT CHARACTERISTICS

Supplier	Model	Capacity	Equipment Cost	Temp. Limit (°F)
Recyclene Products, Inc.	R-2	5 gal./4 hr.	$2,495	<375°
405 Eccles Ave.	RS-20	5 - 7 gph (1)	$11,000	<375°
S.San Francisco,CA 94080	RS-35AF	6 - 8 gph (2)	$21,000	<375°
(415) 589-9600	RX-35AF	12-16 gph (2)	$25,850	<375°
Solvent Distlln.Equip.	LS-Jr.	5 gal./8 hr.	$2,995	<320°
Finish Engineering Co.	LS-15	15 gal./8 hr.	$5,895	<320°
921 Greengarden Rd.	LS-15V	15 gal./8 hr.	$9,390	<500°
Erie, PA 16501				
(814) 455-4478 & (415) 821-4154				

Notes: (1) 4 hours per cycle (2) Continuous operation
Cost Data: November, 1986

Appendix 7, Vendor Literature - Recyclene Products, Inc. describes some equipment available. Model R-2 can reclaim 5 gallons of solvent within 4 hours. The higher capacity unit RS-35 AF is capable of 6 to 8 gallons per hour on a continuous basis.

The Recyclene equipment uses a non-pressurized chamber with a teflon liner and electrical heating to distill the solvent. Water cooling is used to condense the vapors on the cover of the R-2. A shell and tube heat exchanger is used on the RS-20, RS-35AF and RX-35AF units. The solvent is drained to an external receiver.

The Finish Engineering equipment works on a similar principle. Vendor literature for their models LS-Jr. and LS-15 is in Appendix 7.

Comparative economics are shown below:

APPLICATION				RECYCLENE MODEL				SOLVENT DIST.EQUIP. MODEL		
SITE	SIZE	GAL/MO	LABOR RATE	R-2	RS-20	RX35-AF	RS35-AF	LS-15	LS-15V	LS-55 II
FIRM A	20 CARS PER WEEK	10	$20.00	<————		NEGATIVE	PAYBACK	ECONOMICS		————>
FIRM B	500 CARS	70	$38.00	<————		NEGATIVE	PAYBACK	ECONOMICS		————>
	PER MONTH	70	$8.40	9.6 YR	21.9 YR	-	NA	8.5 YR	14.7 YR	-
FIRM C	700 AUTO REPAIR SHOPS	2200	$11.00	-	-	8.5 YR	6.5 YR	-	-	8.8 YR

The bases for these results are:

Firm A: one solvent sink in operation with charges of $16.50 per month for fresh solvent and cost of capital at 6% per annum

Firm B: 10 solvent sinks in operation, current charges of $31.20 per month per sink for solvent sink lease and maintenance service, and cost of capital at 6% per annum.

Firm C: 3800 gallons of fresh solvent required per month, loss of credit of $0.15 per gallon for spent solvent sales, fresh solvent costs of $0.745 per gallon, and cost of capital at 6% per annum.

Discussion of Results

The results show the low volume of solvent normally used at most small to medium repair operations do not justify the added expense of additional equipment and maintenance costs. The larger operations such as Firm B do generate significant volumes of solvent. However, the labor costs to operate the equipment and additional costs for disposal of waste residues are not competitive with current solvent sink lease and maintenance service operations. Only when there are substantial volumes to be recycled do the economics produce results of 6.5 to 8.5 years payback on investment. An example is Firm C where 700 repair operations are serviced.

The detailed results for each of these calculations are presented in Appendix 3 under Payback Economics for On-Site Options for Solvent Recovery.

12.1.2 On-site - Aqueous Wastes Volume Reduction

The suppliers of aqueous waste reduction equipment evaluated are shown in Table 12-2. The types of equipment chosen are for evaporative waste concentration (D&K and Nordale), chemical batch treatment (Wastewater Treatment Systems) and filtration. These represent processes presently commercially available for the scale of operation evaluated.

TABLE 12-2

AQUEOUS WASTE VOLUME REDUCTION SUPPLIERS
AND
EQUIPMENT CHARACTERISTICS

Supplier	Model	Equipment Capacity	Cost
D & K Sales 1433 Lidcombe Ave. So.El Monte, CA 91733 (818) 575-1644	EVAP-85E	85 gallons	$1,995
Nordale Fluid Eliminator 990 Xylite Ave., N.E. Minneapolis, MN 55434 (603) 668-7111 (714) 855-0691	FE-150	150 gallons	$8,000 to $13,000
Wastewater Treatment Sys 440 N. Central Ave. Campbell, CA 95008 (408) 374-3030	_	50 gallons	$15,000 to $18,000

Cost Data: November, 1986

Evaporative Waste Treatment

Evaporative waste concentration drives off water by applying heat to the solution leaving a slurry or semi-dry cake. Problems include the presence of oil which inhibits boiling. Also the solid residue inhibits heat transfer to the solution. Both of these problems are being overcome. The D&K Sales EVAP has just come on the market and is gaining acceptance. The Nordale Fluid Eliminator is provided for comparison. It has not been fully adapted for this application. Chemical treatment (neutralization, precipitation and solids stabilization) has been fully proven. The evaluation shows it economic at the larger scale of application.

The D&K Sales Model EVAP-85 waste evaporator is described in Appendix 7. The equipment processes up to 85 gallons in a batch. Waste oils are skimmed off mechanically for each batch. Waste is pumped into the unit by a vendor-supplied pump. The waste is heated electrically at the bottom plate of the holding tank. Water vapor is drawn off by channeling air through the holding tank with an induced draft fan. Solids accumulate on the bottom of the tank as the water is driven off.

Appendix 7 provides the vendor literature for the Nordale Fluid Evaporator, Model FE-150. The equipment operates with the same concept as the D&K Sales equipment, but uses natural gas to heat the waste solution.

Chemical Waste Treatment

Aqueous hazardous waste is neutralized and precipitated chemically in the Wastewater Treatment Systems Batchmaster equipment for heavy metals reduction. Appendix 7 provides the vendor literature. Our evaluation uses the Batchmaster Models 50 or 200, having 50 or 200 gallons capacity.

The Batchmaster initially treats each batch with a cation polymer to float off dissolved oil and grease. Sulfuric acid is added to adjust the pH to between 2 and 3 where chrome species can be converted from valence $^{+}6$ to valence $^{+}3$. Metabisulfites are added to precipitate the chrome. The pH is then raised to between 9 and 10 with sodium hydroxide. At this point nickel, remaining chromium, and cadmium species are precipitated. The settled sludge is pumped from the bottom of the vessel. The treated water is decanted off the top. The equipment includes a filter press to stabilize the solids at a 50% moisture content.

Comparative Economics are shown below:

APPLICATION				D&K SALES	NORDALE	WASTEWATER TREATMENT SYSTEMS	
			LABOR	MODEL	MODEL	MODEL	
SITE	SIZE	GAL/MO	RATE	85E	FE-150	BM-50	BM-200
FIRM A	20 CARS PER WEEK	90	$20.00	3 YR.	11 YR	<—NEGATIVE—>	
FIRM B	500 CARS PER MONTH	20	$38.00	4 YR.	20 YR	<—NEGATIVE—>	
FIRM C	700 AUTO REPAIR SHOPS	2000	$11.00	3 MO.	6 MO.	2 YR	2 YR.
		5000	$11.00	2 MO.	3 MO.	1.5 YR.	1 YR.

The bases for these results are:

Firm A: One 85 gallon jet spray in operation with current monthly leasing costs of $242.

Firm B: Two hot tanks in operation, with current charges of $93 per month per hot tank for equipment leasing and service.

Cost of capital was set at 6% per annum. Waste volume reduction of 10 to 1 was achieved with the evaporative waste equipment. Waste disposal at a Class 1 landfill had costs of $115 per drum of stabilized waste, and $35 per drum of stabilized solid wastes. Additional costs are incurred for transportation and lab analysis. Appendix 4, Kettleman Hills Treatment Disposal Rate Schedule provides Class 1 disposal costs.

Discussion of Results

The results show the D&K Sales equipment has a 3 to 4 year payback for most medium to large repair operations. The equipment can be improved by adding a filter press to provide a stabilized cake. The chemical treatment methods by Wastewater Treatment Systems currently are only economic at the larger scales of operation. The Nordale equipment resulted in long payback economics at the medium repair shop or large dealership scales of operation. At the larger scales of operation, greater yearly cost savings are realized with chemical treatment technology, even though the evaporation equipment had shorter paybacks due to the lower capital costs. For this reason, the chemical treatment system is preferred. Payback periods are given at both 2000 and 5000 gallons per month to take into account current and anticipated future economics. The individual audit presented only the anticipated economics.

Filtration

In one application, a 25 micron filter bag on a slipstream from the jet spray washers extended the life of the detergent solution. The normal period between solution changes had been on the order of 2 to 4 weeks. By providing a pump-around loop through the 25 micron filter bag, solution life could be extended an additional 2 weeks before additional filtration was necessary.

12.2 Management Practices to Aid Recycling and Resource Recovery

Many automotive repair operations combine solvents and carburetor cleaners with waste oils, resulting in waste management problems. The following practices do not represent all possible alternatives in this area, but only those which would provide immediate benefits.

12.2.1 Solvent Segregation

Proper manifesting and recovery of spent solvent solutions can only occur if small and medium repair operations segregate solvent wastes. Current practice at many operations is to commingle the wastes with the waste oil. Waste oils are manifested under NA 1270, Waste Petroleum Oil. Spent solvent wastes are manifested as UN 1268 or UN 1255, Waste Petroleum Distillate as a combustible liquid hazard class.

12.2.2 Carburetor Cleaner Segregation

Similarly, carburetor cleaner is often mixed with waste oils. Carburetor cleaner is a corrosive liquid manifested under NA 1760. This waste should be accumulated separately for proper waste management.

12.2.3 Incentives to Process Small Quantities of Waste

Given the current poor economics for on-site recycling of spent solvents (see Section 12.1.1), greater incentives are needed to promote use of a solvent service to pick up these wastes. This would be for generators with or without the use of leased solvent equipment. Typical quantity for pickup is 55 gallons. This must be economical in order to be picked up. Chapter 11 analyzes the economics for waste hauler pickup of wastes. Most small to medium repair shops cannot justify the economics.

12.2.4 Good Housekeeping Practices

Good housekeeping practices can minimize losses to the municipal or storm sewer. Typical examples would include the following:

- an employee education program for hazardous wastes disposal procedures
- proper on-site labelling of hazardous wastes
- separate containers for hazardous wastes
- convenient location of cleaning equipment to automotive service bays
- proper trash/solids separation prior to collection for waste recycling or treatment

CHAPTER 13

OFF-SITE TREATMENT AND RECYCLING

Several alternatives are available for off-site recycling or disposal of hazardous waste materials identified in this audit study. Waste exchange options per the California Waste Exchange are included.

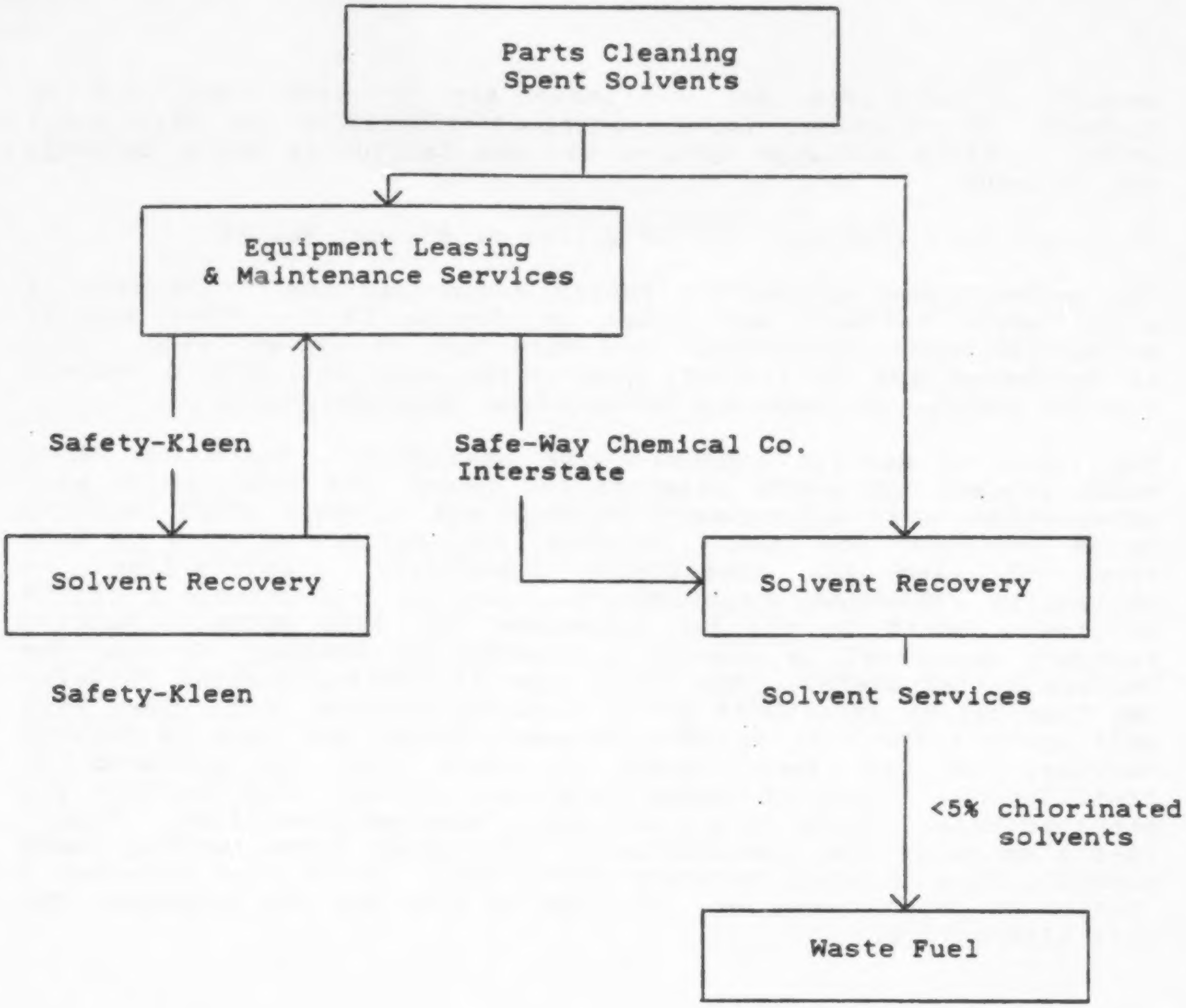
13.1 Off-Site Treatment and Recycling of Solvent Wastes

The methods many automotive repair businesses use to recycle or reuse waste solvents are shown in Figure 13-1. Over 95% of automotive repair operations have some type of solvent sink. Only an estimated 40% to 50% of these firms contract with a solvent service company to lease and/or maintain this equipment.

Two types of service companies are available. There are those which process the waste solvents for reuse, and those which sell waste solvents to a Treatment, Storage and Disposal (TSD) facility to be processed for fuel. On-site, the service offered by both types of firm are essentially identical. Safety-Kleen, a nationally franchised organization, recovers approximately 10,000 gallons a month in the San Francisco Bay Area alone. Solvent recovery equipment is centrally located at Reedley, CA for the Western United States. The other type of service company is Safe-Way Chemical or Interstate Parts Cleaning Service, Inc. They will sell waste solvent to solvent recovery operations such as Solvent Services of San Jose, where a waste fuel is produced by distillation. Each of these companies recover 2000 gallons per month or more. Table 11-4 lists the companies identified. Figure 13-1 also shows the possibility of individual firms sending waste directly to a solvent recovery contractor. Table 11-2 provides a listing of those companies. Chapter 11 provides the economics for this alternative.

Figure 13-1

Off-Site Waste Solvent Recycling


Parts Cleaning
Spent Solvents
Equipment Leasing
& Maintenance Services
Safety-Kleen
Safe-Way Chemical Co.
Interstate
Solvent Recovery
Solvent Recovery
Safety-Kleen
Solvent Services
<5% chlorinated
solvents
Waste Fuel

13.2 Off-Site Treatment and Recycling of Carburetor Cleaner

Smaller quantities of carburetor cleaner are used and generated for disposal. Figure 13-2 shows the current options.

Figure 13-2

Off-Site Waste Carburetor Cleaner Recycling

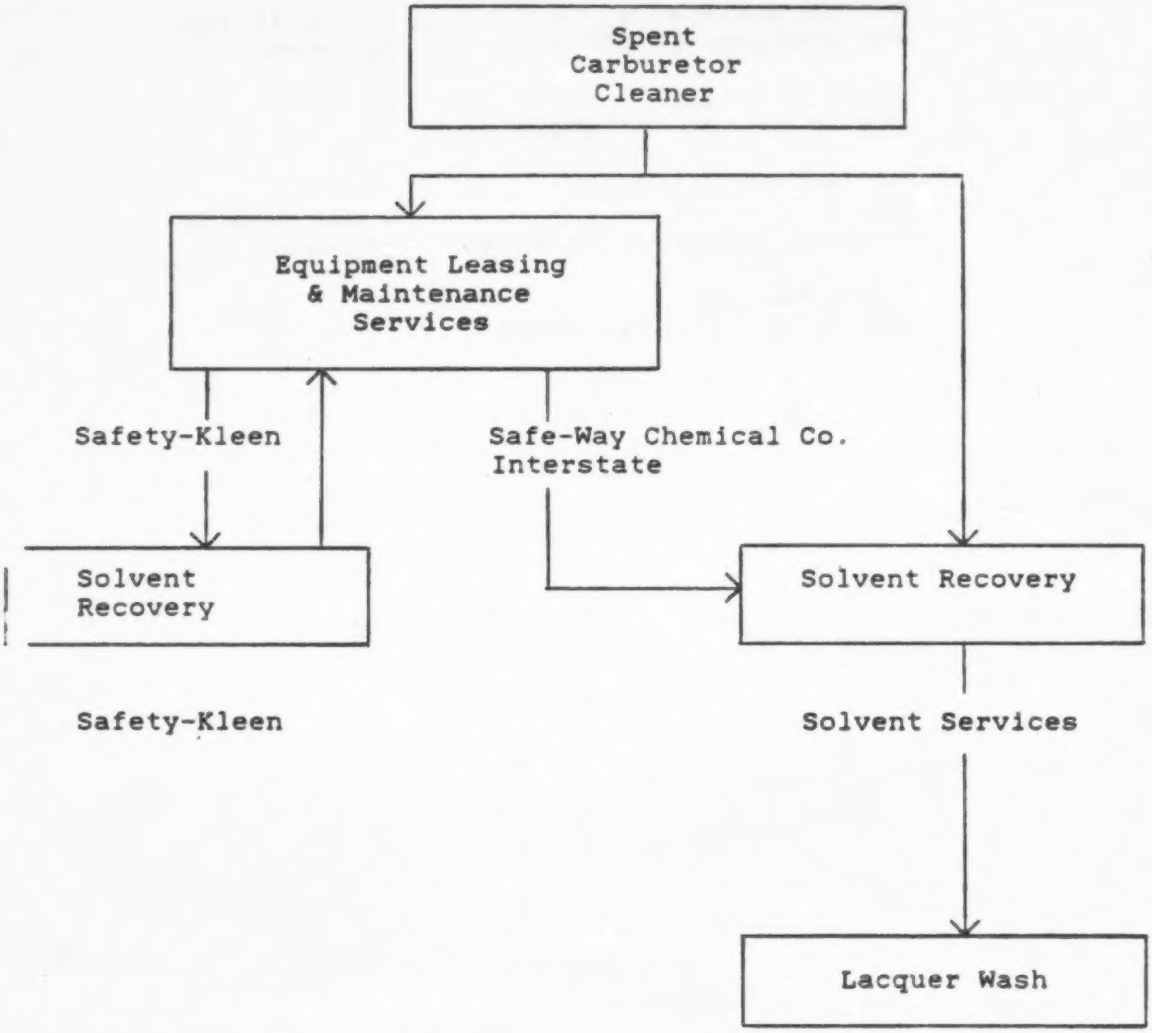

Spent Carburetor Cleaner
Equipment Leasing & Maintenance Services
Safety-Kleen
Safe-Way Chemical Co. Interstate
Solvent Recovery
Solvent Recovery
Safety-Kleen
Solvent Services
Lacquer Wash

Table 13-1

Battery Processors & Smelters

Service	Company	
Processing	Battery Exchange 2195 Story Rd. San Jose, CA 95122 (408) 251-3493	7000 lb./mo. processed
Smelting	GNB, Inc.- Metals Div. 2700 S.Indiana St. Los Angeles, CA 90023 (213) 262-1101 EPA ID No. CAD 097854541	9,000 lb.min. shipment
Smelting	RSR Quemetco, Inc. 720 S. 7th Ave. City of Industry, CA 91746 (800) 527-9452 EPA ID No. CAD 066233966	7,500 lb.min. shipment

GLOSSARY OF ABBREVIATIONS

CFR	Code of Federal Regulations
CWE	California Waste Exchange
DHS	California Department of Health Services
DOT	United States Department of Transportation
EPA	United States Environmental Protection Agency
MSDS	Material Safety Data Sheet
OSW	Office of Solid Waste
RCRA	Resource Conservation and Recovery Act
SIC	Standard Industrial Classification
SQG	Small Quantity Generator
TSD	Treatment, Storage and Disposal

APPENDICES

APPENDIX 1

INDIVIDUAL WASTE AUDITS

WESLEY M. TOY, P.E.
18805 Cox Avenue, Suite 120, Saratoga, CA 95070

Consulting Engineer
California Reg. Ch. 3260
(408) 374-4579

October 30, 1986

FIRM A

Attn:

Subject: Dept. of Health Services (DOHS), RFP 86 - 024
Waste Audit Study on Automotive Repairs

Dear

The enclosed waste audit was performed on the operations of your firm on the above referenced contract with DOHS.

Our conclusions on methods by which you could reduce your aqueous and solvent waste generation are given in Section 2. We would recommend isolation of spent solvents and carburetor cleaners for proper disposal. Use of a leased solvent sink and maintenance service would be economical compared to current solvent purchase and proper solvent disposal costs. In addition further savings would be made by non use of mechanic time for maintenance work.

Other recommendations to minimize off site waste disposal would be installation of an aqueous jet spray washer waste evaporator such as discussed in Section 2A. Payback periods range from 3 to 5 years depending upon purchase or lease of a jet spray washer.

Sources for proper disposal of the carburetor cleaner and antifreeze solution are also provided.

Please feel free to discuss these results with me further.

Very truly yours,

Wesley M. Toy

Wesley M. Toy, P.E.

Enclosures

WASTE AUDIT - FIRM A

1. GENERAL OPERATION-CHARACTERISTICS

A. Description:

Firm A is a general automotive repair operation specializing in transmission services.

B. Size:

20 Cars serviced per week
6 general car maintenance bays

C. Service Provided:

60% transmission servicing
10% engine repair
20% brake servicing
10% other

D. Raw Materials:	Quantity		Generic		
	Vol/Mo	Lb/Mo	Description	Hazard Class	UN/NA I.D. Number
Parts Cleaning Solvent Chevron 350	10 gals	65	Paraffin Solvent bp 310-370 deg.F	Combustible Liquid	UN 1268
Parts Washing Detergent Safeway HT-E-13	Solid	25	Alkaline Detergent	None	-
Carburetor Cleaner Strip Solvent	8 gals	78	45% Methylene Chloride	Corrosive Material	UN 1760
Antifreeze Solution	11 gals	102	Ethylene Glycol	Hazardous Liquid	NA 1142
Engine Oil	60 gals	420	Petroleum Oil	Combustible Liquid	NA 1270
Sawdust Absorbant	2 bags	100	Sawdust (50 lb ea)	None	None
Lead-Acid Batteries	3 bat	60	Lead Dross(cont. >=3% free acid)	ORM-C	NA 1 / 94

E. Waste Generated:	Quantity				
	Vol/Mo	Lb/Mo	DOT Shipping Name	Hazard Class	UN/NA I.D. Number
Spent Solvent	7 gals	54	Waste Petroleum Dist.	Combustible Liquid	UN 1268
Aqueous Detergent Waste(1)	90 gals	756	Waste Corr.Liquid,N.O.S.	Corrosive Liquid	UN 1760
Carburetor Cleaner	8 gals	78	Waste Cpd.Clng.Liquid	Corrosive Liquid	NA 1760
Spent Antifreeze Solution	32 gals	282	Waste Liquid	ORM-E	UN 9189
Waste Engine Oil	55 gals	385	Waste Petroleum Oil	Combustible Liquid	NA 1270
Spent Sawdust		110	Waste Corr.Solid N.O.S.	Hazardous Solid	UN 1759
Spent Lead-Acid Batteries	3 bat	60	Lead Dross(cont. >=3% free acid)	ORM-C	NA 1 / 94

(1) Replacement of total contents of tank

F. Equipment Used:

1 - 85 gallon jet spray parts washer
2 - 5 gallon solvent buckets
1 - 5 gallon carburetor cleaner bucket

G. Current Disposal Practices:	Method
Spent Solvent	Mixed with waste oil
Aqueous Detergent Waste	Picked up by equipment service company
Carburetor Cleaner	Mixed with waste oil
Spent Antifreeze Solution	Put to municipal sewer
Waste Engine Oil	Picked up by waste oil service company
Sawdust	Put to municipal waste dumpster

H. Material Losses:			Losses
Parts Cleaning Solvent	3 gals	23	Evaporation and spillage
Grease and Oil		2	To storm sewer from paving

I. Prioritized Sites of Significant Waste Generation:

Action Priority	Hazard Priority	Waste Type	On-site Source	Waste lb/mo	Manifesting Required?	Criteria for Waste Determination
1	5	Aqueous Detergent Waste	Jet spray parts washer	756	Yes	Aq.Waste w.Metals
4	5	Carburetor Cleaner	5 gallon dunk bucket	78	Yes	Chlorinated solvent with Metals
4	4	Parts Cleaning Solvent	5 gallon dunk barrel	54	Yes	Waste Solvent with Metals
3	2	Spent Antifreeze Soln.	Auto radiators	282	Yes	Hazardous Liquid
1	1	Waste Engine Oil	Engine crankcase	385	Yes	Combustible Liquid
1	2	Spent Sawdust	Floor sweep-up	110	Yes	Oil,Grease & Metals

Priority scale: 1 = Low 5 = High

2. WASTE MANAGEMENT OPTIONS

A. General Practice

- Isolation of spent solvent wastes and carburetor cleaner is necessary to avoid contamination of waste oils.

- The most hazardous waste generated, aqueous detergent wastes, is produced by the jet spray washer. The current practice of servicing by the equipment leasing company should be continued to properly dispose and manifest wastes shipped off-site.

- Spent motor oils in 8 miscellaneous containers ranging in size from 5 to 30 gallons should be put to waste oils or moved to engine use to avoid spills to the pavement and runoff to the storm sewer.

- Clean-up and maintenance of the back parts storage and rear driveway service area will prevent oil and grease run-off to the storm sewer.

B. Specific Management Options:

1. Solvent

- Use solvent equipment leasing and maintenance service.

Costs: range from $34 to $38 per month (See Table A-2) for a sink with a recirculation system and spent solvent pick-up and fresh solvent recharge.

Current	10 gal fresh solvent @ $1.65/gal..........	$16.50	
Costs:	disposal costs @ 7 gal/mo & $2.36/gal.....	$16.52	(Solvent Services, Inc.)
	total costs..........................	$33.02	

Costs for conversion to a solvent leasing and maintenance service are only operating costs (no capital expense) with purchase and disposal of solvent in 55 gallon drum quantities. Costs are shown at nearly break-even and would be better than breakeven if labor for sink maintenance and transportation costs for spent solvents are included. Improved solvent quality is an expected benefit with a solvent sink.

- Use of on-site solvent recovery equipment is not recommended at this level of solvent use.

2. Aqueous Detergent Wastes:

- The jet spray used on a lease and maintenance contract from Safeway Chemical provides good containment and recovery of aqueous wastes high in heavy metal contaminants.

Table A-1 shows that a D & K Sales aqueous waste evaporator could be used at Firm A with a less than 5 year pay-back period with a purchased jet spray, or with a slightly over 3 year pay-back period if the jet spray were leased from Safeway Chemical. These costs include increased labor to operate and maintain both the jet spray and the waste disposal equipment, plus solid waste disposal costs.

The basis for this evaluation is:

- 1 - 85 gallon jet spray washer
- 90 gallons of aqueous detergent waste processed per month
- Labor rate at $20.00 per hour to operate equipment
- Current average monthly costs of $242 for lease and maintenance contract
- Cost of capital at 6% per annum.

Other aqueous waste concentrators, shown in Table A-3, were evaluated which use natural gas or precipitation and filtration for waste reduction, but these proved uneconomical.

3. **Carburetor Cleaner:**

- The current method of disposal of 8 gal/mo carburetor cleaner via the waste oil is unacceptable.

  Options are currently:

  a) purchase of the product from a supplier who provides disposal of the spent cleaner in his costs.
  Safety Kleen cost: $60 per 5 gallons (408) 294-8778
  b) disposal of the spent solution at a toxic substances disposal facility
  1. Solvent Services, cost: $357 per 55 gallons (408) 286-6446
  2. Zero Waste, cost: $325 per 55 gallons (415) 893-8257

  With current product costs of $21 per 5 gallons, incremental costs would be:

  Option a) Additional $39 per 5 gallons
  Option b1) Additional $32 per 5 gallons
  Option b2) Additional $30 per 5 gallons

4. **Spent Antifreeze Solution:**

- Spent Antifreeze solution should be accumulated in 55 gallon drums and processed as a hazardous waste.

  California Oil Recyclers, Belmont CA, (415) 591-2603 is a licensed waste handler granted a variance by DHS to transport and dispose of spent antifreeze solutions.

  Costs: $72.50 per hour with a 3 hour minimum
  In addition, a $0.30 per gallon fee is charged for disposal.

5. Waste Engine Oil:

- Waste engine oils are presently shipped off-site by a licensed waste handler.

  California Oil Recyclers (see 4. above) provides this service for a flat fee of $40.00 for each pickup

6. Waste Sawdust Absorbant:

- Sawdust should be properly disposed of as a diluted hazardous waste.

  Options would include use of an aqueous detergent-based cleaner and processing of the waste generated in the equipment recommended in Section B2 for jet spray wastes.

7. **Spent Acid Batteries:**

- Currently being sent to spent lead acid battery processor.

TABLE A-1

DETERGENT WASTE VOLUME REDUCTION OPTIONS
BASIS: 1 YEAR

ITEM	UNIT DESCRIPTION: D&K MODEL 85-E OPTION: BUY JET-SPRAY	D&K MODEL 85-E LEASE JET-SPRAY
UNIT COST:	$1,995	$1,995
JET SPRAY PURCHASE:	$3,700	
INSTALLATION:	$500	$500
TOTAL CAPITAL COST:	$6,195	$2,495
UNIT CHARACTERISTICS:		
GALLONS/CHARGE:	85	85
UNIT POWER, KW:	11.78	11.78
GAS USAGE,BTU/HR:		
GAS USAGE,THERMS/HR:		
DISTILLATION RATE,GPH:	4.5	4.5
HRS/CYCLE:	22.19	22.19
CYCLES/MO.:	1.1	1.1
% OF MAXIMUM CAPACITY:	3.34%	3.34%
WATER RATE, GPH:	50	50
WATER USAGE,CF/YR:	1890	1890
LABOR, HRS/CHARGE:	0.5	0.5
JET-SPRAY & HOT TANK,G/MO:	90	90
PERCENT REDUCTION:	90%	90%
DISCARD VOLUME, GAL/MO:	9	9
MAINTENANCE MATLS,$/YR:	$20	$0
LABOR,HRS/SLUDGE REM.CYCLE	0.5	0.5
LABOR,HRS/YR,MAINT.:	4	0
LABOR RATE,$/HR:	$20.00	$20.00
OPERATING COSTS, $/YR:		
POWER $ @$0.10/KWH:	$285	$285
GAS @ 0.50/THERM:		
WATER @ $0.0089/CF:	$17	$17
CHEMICALS @ $0.97/GAL:	$432	$0
MAINT MATERIALS:	$20	$0
SLUDGE REM.,(SAFE-WAY):	$362	$362
JET-SPRAY LEASE:		$1,271
LABOR:		
SLUDGE COLLECTION:	$127	$127
MAINTENANCE:	$80	$0
TOTAL OPERATING COSTS:	$1,323	$2,062
SAFE-WAY COST:	$2,903	$2,903
YEARLY COST SAVINGS:	$1,580	$841
BREAKEVEN @ 6%:	4.5 yr.	3.3 YR.

TABLE A-2

SOLVENT EQUIPMENT LEASING AND MAINTENANCE SERVICES

- o Monthly leasings of a solvent sink with recirculation pump.
- o Monthly general maintenance service with removal of spent solvent and replacement with fresh solvent.

Company	Cost (approximate)
Safe-Way Chemical Co. (408) 292-4289 11 gal solvent/22 gal barrel	$38.00
Interstate Parts Cleaning Service, Inc. (408)255-2300 10 gal solvent/16 gal barrel	$33.75
Safety Kleen Corp. (408) 294-8778 10 gal solvent/16 gal barrel	$36.75

TABLE A-3

AQUEOUS WASTE VOLUME REDUCTION EQUIPMENT SUPPLIERS

SUPPLIER	MODEL	EQUIPMENT CAPACITY	COST
D & K Sales EVAP 1433 Lidcombe Ave. So.El Monte, CA 91733 (818) 575-1644	85-E	85 gallon	$ 1,995
Nordale Fluid Eliminator 990 Xylite Ave., N.E. Minneapolis MN 55434 (603) 668-7111	1000-MS	150 gallon	$ 8,000 - $13,000
Wastewater Treatment Systems 440 N. Central Ave. Campbell, CA 95008 (408) 374-3030	-	50 gallon	$15.000 - $18,000

WESLEY M. TOY, P.E.
18805 Cox Avenue, Suite 120, Saratoga, CA 95070

Consulting Engineer
California Reg. Ch. 3260
(408) 374-4579

October 30, 1986

FIRM B

Attn:

Subject: Dept. of Health Services (DOHS), RFP 86 - 024
Waste Audit Study on Automotive Repairs

Dear

The enclosed waste audit was performed on the operations of your firm on the above referenced contract with DOHS.

Our conclusions on methods by which you could reduce your aqueous and solvent waste generation are given in Section 2. Current operations have equipment leasing and service contracts for both solvent sinks and hot tanks used on site. Further reduction of waste volumes sent off-site would be by use of solvent recovery and/or aqueous volume reduction equipment on-site.

Our analysis shows that for the solvent used the additional equipment would be uneconomical with the current labor rates of $38per hour for operation and and maintenance of solvent and recovery equipment. Payback periods of 8 to 9 years are possible only if a reduced labor rate of $8.40 per hour were available. If aqueous evaporation equipment were used a payback period of 4 years is possible with the current labor rates of $38.

As shown in Section II all significant wastes are being disposed of properly. The relatively high labor rates and additional management responsibility make the installation of solvent recovery equipment questionable . Aqueous waste reduction is more favorable but still demands additional management time to oversee proper operation. This also is questionable but viable economically.

Areas which require further attention are in proper disposal of waste from the pressure spray cleaning bay waste sump. The material accumulated is high in oil and grease content and heavy metal components. Proper disposal of contaminated sawdust as a diluted waste material is also required.

Please fell free to discuss these results with me further.

Very truly yours,

Wesley M. Toy, P.E.

Attachments

WASTE AUDIT - FIRM B

1. GENERAL OPERATION-CHARACTERISTICS

A. Description:

Firm B is an automobile dealership providing new car maintenance service and repair for factory warranted cars.

B. Size:

500 Cars serviced per month
25 General car maintenance bays, 5 wheel alignment bays, 9 auto painting bays

C. Service Provided:

25% periodic auto maintenance
5% transmission maintenance
10%-12% engine repair
2%-3% brake servicing
4%-5% front end alignment
30%-35% light duty, noise/warranty
10% tune up
5% other

D. Raw Materials:	Quantity Vol/Mo	Quantity Lb/Mo	Generic Description	Hazard Class	UN/NA I.D. Number
Parts Cleaning Solvent Chevron 350	100 gal	650	Paraffin Solvent bp 310-370 deg.F	Combustible Liquid	UN 1255
Parts Washing Detergent					
Safeway HT-E-13	solid	10	Alkaline Detergent	None	-
Safeway 9862	solid	7	Caustic Soda & Srfctnts.	Corrosive Solid	UN 1759
Carburetor Cleaner	10 gals	98	32% Methylene Chloride & 12% Cresylic Acid	Corrosive Material	NA 1760
Antifreeze Solution	40 gals	372	Ethylene Glycol	Hazardous Liquid	NA 1142
Engine Oil	330 gal	2310	Petroleum Oil	Combustible Liquid	NA 1270
Sawdust Absorbant	10 bags	500	Sawdust (50 lb ea)	None	None
Lead-Acid Batteries	10 bat	200	Lead Dross(cont. >=3% free acid)	ORM-C	NA 1 / 94
Detergent - floor				None	None

E. Waste Generated:	Quantity Vol/Mo	Quantity Lb/Mo	DOT Shipping Name	Hazard Class	UN/NA I.D. Number
Spent Solvent	80 gals	616	Waste Petroleum Dist.	Combustible Liquid	UN 1255
(1) Aqueous Detergent Waste	10 gals	84	Waste Corr.Liquid,N.O.S.	Corrosive Liquid	UN 1760
(1) Aq.Caustic Detergent Waste	10 gals	84	Waste Corr.Liquid,N.O.S.	Corrosive Liquid	UN 1760
Carburetor Cleaner	10 gals	98	Waste Cpd.Clng.Liquid	Corrosive Liquid	NA 1760
Spent Antifreeze Solution	100 gal	880	Waste Liquid	ORM-E	UN 9189
Waste Engine Oil	300 gal	2100	Waste Petroleum Oil	Combustible Liquid	NA 1270
Spent Sawdust		550	Waste Corr.Solid N.O.S.	Hazardous Solid	UN 1759
Lead-Acid Batteries	10 bat	200	Lead Dross(cont. >=3% free acid)	ORM-C	NA 1 / 94
Detergent for Floor Wash	Not available		Waste Corrosive Liquid	Corrosive Liquid N.O.S.	UN 1760
Steam Out Waste Sump	Not available		Waste Corr.Solid N.O.S.	Corrosive Solid	UN 1759

(1) Ten gallons removed monthly from 60 gallon tank

F. Equipment Used:

10 - 10 gal solvent/16 gal barrel solvent sinks
2 - 5 gal agitator-type carburetor cleaners
1 - 60 gal hot tank - aluminum metal, detergent based
1 - 60 gal hot tank - ferrous metal, caustic based

G. Current Disposal Practices:	Method
Spent Solvent	Monthly service by equip/solvent lease
Aqueous Detergent Waste	Monthly service by equip/chem lease & maintenance company
Aq.Caustic Detergent Waste	Monthly service by equip/chem lease & maintenance company
Carburetor Cleaner	Monthly service by equip/chem lease & maintenance company
Spent Antifreeze Solution	Picked up by waste liquid service company
Waste Engine Oil	Picked up by waste oil service company
Sawdust	Put to municipal waste dumpster
Lead-Acid Batteries	Return to battery recycler
Detergent for Floor Wash	Put to municipal sewer
Steam Out Waste Sump	Municipal waste dumpster

H.Material Losses:	Quantity Vol/Mo	 Lb/Mo	Losses
Parts Cleaning Solvent	20 gals	130	Evaporation and spillage

I. Prioritized Sites of Significant Waste Generation:

Action Priority	Hazard Priority	Waste Type	On-site Source	Waste lb/mo	Manifesting Required?	Criteria for Waste Determination
1	5	Aqueous Detergent Waste	Hot tank-Aluminum metal	84	Yes	Aq.Waste w.Metals
1	5	Aq.Caustic Deterg.Waste	Hot tank-Ferrous metals	84	Yes	Aq.Waste w.Metals
1	5	Carburetor Cleaner	55 gallon dip tank	98	Yes	Chlorinated Solvent with Metals
1	4	Spent Solvent	Solvent sinks	616	Yes	Waste Solvent with Metals
1	2	Spent Antifreeze Soln.	55 gal collection drum	880	Yes	Corrosive Material
1	2	Waste Engine Oil	1000 gal storage tank	2100	Yes	Combustible Liquid
2	1	Sawdust	Service bays	550	Yes	Oil,Grease & Metals
1	1	Lead-Acid Batteries		200	Yes	Lead Dross
2	1	Detergent, Floor Wash	Wash buckets		Yes	Waste Liquid w.Oil
3	5	Oily,Metals-contam.Dirt	Steam out waste sump	N.Avl.	Yes	Corrosive Solids

Priority scale: 1 = Low 5 = High

2. WASTE MANAGEMENT OPTIONS

A. General Practice

- General practice of leasing of solvent parts washers, hot tanks, and agitator-type carburetor cleaners and contracting for monthly maintenance with chemical removal and fresh chemical make-up should be continued to minimize losses and maintain solution quality. Manifesting is being performed by equipment service companies.
- Spent antifreeze solution is being properly disposed of by a waste management service.
- Steam cleaning waste sump should be properly disposed of to a Class I type dump site due to a high heavy metals content.

B. Specific Management Options:

1. Solvent

- Current practice of containment and recirculation of solvent in parts washers provides minimum solvent losses. Solvent sinks are serviced on a monthly basis. Further economy could be achieved by use of an on-site solvent recovery device. An analysis of the application economics for two types of solvent distillation device is shown in Tables A-4 and A-5, Waste Solvent Recovery Options.

The bases for these evaluations are:

- 10 solvent sinks in operation
- 70 gallons of solvent processed per month
- Labor rate at $38 per hour to operate equipment
- Current charge of $31.20 per month per sink for solvent sink lease and maintenance service
- Cost of capital at 6% per annum

The conclusions are:

- Use of an on-site recovery device manufactured by either Recyclene or Solvent Distillation Equipment is not economical for the current internal labor rate of $38 per hour.. Table A-4 shows that a yearly positive savings is not achieved for any of the model sizes available. Depreciation of capital equipment was not included in the evaluation.
- Lower labor costs of $8.40 per hour to service and maintain the solvent sinks and solvent recovery device would be needed to recover the capital investment in 8 years as shown in Table A-5.

Table A-7 lists the suppliers of the solvent recovery equipment evaluated.

2. Aqueous or Alkaline Detergent Wastes:

- The current practice of hot tank lease and maintenance by Safeway Chemical Co. provides minimum losses and maintains solution activity. Further economy could be achieved by use of an on-site aqueous waste concentrator. Table A-6 shows that a D & K Model 85-E Waste Concentrator could recover initial capital costs in slightly over four years operation.

The basis for the evaluation is:

- 2 hot tanks in operation
- 20 gallons of hot tank solution processed per month
- Labor rate @ $38 per hour to operate equipment
- Current charges of $93 per month per hot tank for equipment leasing and service.
- Cost of capital at 6% per annum

Other commercially available aqueous waste concentrators were evaluated which use natural gas or precipitation and filtration for waste reduction, but these proved uneconomical.

Table A-8 lists the suppliers of the waste reduction equipment.

WASTE AUDIT - FIRM B
BASIS: 1 YEAR
10 SINKS, 10 GAL EA.
$38.00 LABOR RATE

TABLE A-4

WASTE SOLVENT RECOVERY OPTIONS

ITEM	MANUFACTURER AND MODEL NUMBER RECYCLENE R2	RECYCLENE RS-20	RECYCLENE RS-35AF	SDE LS-JR	SDE LS-15	SDE LS-15V
UNIT COST:	$2,495	$11,000	$21,000	$2,995	$5,895	$9,390
SINKS:	$3,500	$3,500	$3,500	$3,500	$3,500	$4,900
INITIAL SOLVENT CHARGE:	$165	$165	$165	$165	$165	$231
TOTAL CAPITAL COST:	$6,160	$14,665	$24,665	$6,660	$9,560	$14,521
UNIT CHARACTERISTICS:						
GALLONS/CHARGE:	5	20	50	5	15	15
UNIT POWER, KW:	0.55	1.65	2.5	0.5	1.65	2.35
DISTILLATION RATE,GPH:	1.25	5	7.17	0.625	1.875	1.875
HRS/CYCLE:	5	5.5	24	8	8	8
BAG COST,$:	$15.00	$41.00	$45.42	$0.00	$0.00	$0.00
WATER RATE, GPH:	8	40	75	11.25	30	30
WATER USAGE,CF/YR:	901	1239	4054	2027	1802	1952
CHARGES/BAG:	5	5	5	1	1	1
LABOR, HRS/CHARGE:	0.33	0.5	0.5	0.6	0.6	0.6
SINK CHARACTERISTICS:						
# OF SINKS:	10	10	10	10	10	14
SOLVENT, GAL/SINK:	10	10	10	10	10	10
% LOSS:	30%	30%	30%	30%	30%	30%
SOLVENT CHANGES/YR:	12	12	12	12	12	9.29
MAINTENANCE MATLS,$/YR:	$15	$15	$15	$15	$15	$15
LABOR HRS/SOLVENT CHANGE:	0.33	0.33	0.33	0.33	0.33	0.33
LABOR,HRS/YR/SINK,MAINT.:	4	4	4	4	4	4
LABOR RATE,$/HR:	$38.00	$38.00	$38.00	$38.00	$38.00	$38.00
OPERATING COSTS:						
POWER $ @$0.10/KWH:	$46	$38	$101	$67	$74	$114
WATER @ $0.0089/CF:	$8	$11	$36	$18	$16	$17
BAG COST:	$504	$344	$153	$0	$0	$0
SINK MAINT MATLS:	$150	$150	$150	$150	$150	$210
SOLVENT REPLACEMENT:	$594	$594	$594	$594	$594	$644
LABOR:						
SOLVENT HANDLING,SINKS:	$1,505	$1,505	$1,505	$1,505	$1,505	$1,630
SINK MAINTENANCE:	$1,520	$1,520	$1,520	$1,520	$1,520	$2,128
DISTILLATION LABOR:	$333	$126	$50	$605	$202	$219
SLUDGE PICKUP:	$225	$225	$225	$225	$225	$225
CARB.CLNR.PICKUP:	$385	$385	$385	$385	$385	$0
TOTAL OPERATING COSTS:	$5,269	$4,898	$4,718	$5,068	$4,670	$5,187
INTERSTATE SERVICE COST:	$3,745	$3,745	$3,745	$3,745	$3,745	$3,745
YEARLY COST SAVINGS:	($1,525)	($1,153)	($974)	($1,324)	($925)	($1,442)
BREAKEVEN @ 6%:	NA	NA	NA	NA	NA	NA

WASTE AUDIT - FIRM B
BASIS: 1 YEAR
10 SINKS, 10 GAL EA.
$8.40 LABOR RATE

TABLE A-5

WASTE SOLVENT RECOVERY OPTIONS

ITEM	MANUFACTURER AND MODEL NUMBER					
	RECYCLENE R2	RECYCLENE RS-20	RECYCLENE RS-35AF	SDE LS-JR	SDE LS-15	SDE LS-15V
UNIT COST:	$2,495	$11,000	$21,000	$2,995	$5,895	$9,390
SINKS:	$3,500	$3,500	$3,500	$3,500	$3,500	$4,900
INITIAL SOLVENT CHARGE:	$165	$165	$165	$165	$165	$231
TOTAL CAPITAL COST:	$6,160	$14,665	$24,665	$6,660	$9,560	$14,521
UNIT CHARACTERISTICS:						
GALLONS/CHARGE:	5	20	50	5	15	15
UNIT POWER, KW:	0.55	1.65	2.5	0.5	1.65	2.35
DISTILLATION RATE, GPH:	1.25	5	7.17	0.625	1.875	1.875
HRS/CYCLE:	5	5.5	24	8	8	8
BAG COST, $:	$15.00	$41.00	$45.42	$0.00	$0.00	$0.00
WATER RATE, GPH:	8	40	75	11.25	30	30
WATER USAGE, CF/YR:	901	1239	4054	2027	1802	1952
CHARGES/BAG:	5	5	5	1	1	1
LABOR, HRS/CHARGE:	0.33	0.5	0.5	0.6	0.6	0.6
SINK CHARACTERISTICS:						
# OF SINKS:	10	10	10	10	10	14
SOLVENT, GAL/SINK:	10	10	10	10	10	10
% LOSS:	30%	30%	30%	30%	30%	30%
SOLVENT CHANGES/YR:	12	12	12	12	12	9.29
MAINTENANCE MATLS. $/YR:	$15	$15	$15	$15	$15	$15
LABOR, HRS/SOLVENT CHANGE:	0.33	0.33	0.33	0.33	0.33	0.33
LABOR, HRS/YR/SINK, MAINT.:	4	4	4	4	4	4
LABOR RATE, $/HR:	$8.40	$8.40	$8.40	$8.40	$8.40	$8.40
OPERATING COSTS:						
POWER $ @$0.10/KWH:	$46	$38	$101	$67	$74	$114
WATER @ $0.0089/CF:	$8	$11	$36	$18	$16	$17
BAG COST:	$504	$344	$153	$0	$0	$0
SINK MAINT MATLS:	$150	$150	$150	$150	$150	$210
SOLVENT REPLACEMENT:	$594	$594	$594	$594	$594	$644
LABOR:						
SOLVENT HANDLING, SINKS:	$333	$333	$333	$333	$333	$360
SINK MAINTENANCE:	$336	$336	$336	$336	$336	$470
DISTILLATION LABOR:	$333	$126	$50	$605	$202	$218
SLUDGE PICKUP:	$225	$225	$225	$225	$225	$225
CARB. CLNR. PICKUP:	$385	$385	$385	$385	$385	$0
TOTAL OPERATING COSTS:	$2,913	$2,542	$2,362	$2,712	$2,314	$2,259
INTERSTATE SERVICE COST:	$3,745	$3,745	$3,745	$3,745	$3,745	$3,745
YEARLY COST SAVINGS:	$832	$1,203	$1,382	$1,032	$1,431	$1,486
BREAKEVEN @ 6%:	9.8 YR	21.9 YR.	>25 YR.	8.2 YR.	8.5 YR.	14.7 YR.

TABLE A-6

DETERGENT AND ALKALI
WASTE REDUCTION OPTION

BASIS: 1 YEAR
2 HOT TANKS
LABOR RATE: $38/HR.& $8.40/HR.

	MANUFACTURER AND MODEL NUMBER	
ITEM	D&K MODEL 85-E	D&K MODEL 85-E
UNIT COST:	$1,995	$1,995
HOT TANKS,2 EA.:	$500	$500
INSTALLATION:	$500	$500
TOTAL CAPITAL COST:	$2,995	$2,995
UNIT CHARACTERISTICS:		
GALLONS/CHARGE:	85	85
UNIT POWER, KW:	11.78	11.78
GAS USAGE,BTU/HR:		
GAS USAGE,THERMS/HR:		
DISTILLATION RATE,GPH:	4.5	4.5
HRS/CYCLE:	22.19	22.19
CYCLES/MO.:	0.2	0.2
% OF MAXIMUM CAPACITY:	0.74%	0.74%
WATER RATE, GPH:	50	50
WATER USAGE,CF/YR:	420	420
LABOR, HRS/CHARGE:	0.5	0.5
HOT TANK,G/MO:	20	20
PERCENT REDUCTION:	90%	90%
DISCARD VOLUME, GAL/MO:	2	2
MAINTENANCE MATLS,$/YR:	$20	$20
LABOR,HRS/HOT TANK CHANGE:	0.5	0.5
LABOR,HRS/YR,MAINT.:	4	4
LABOR RATE,$/HR:	$38.00	$8.40
OPERATING COSTS, $/YR:		
POWER $ @$0.10/KWH:	$63	$63
GAS @ $0.50/THERM:		
WATER @ $0.0089/CF:	$4	$4
CHEMICALS @ $0.20/GAL:	$48	$48
CHEMICALS @ $0.97/GAL:		
MAINT MATERIALS:	$20	$20
SLUDGE REM.,(STABILIZED):	$600	$600
LABOR:		
HOT TANK COLLECTION:	$456	$101
UNIT OPERATION:	$54	$12
MAINTENANCE:	$152	$34
TOTAL OPERATING COSTS:	$1,397	$881
SAFE-WAY COST:	$2,235	$2,235
YEARLY COST SAVINGS:	$838	$1,354
BREAKEVEN @ 6%:	4 YR.	3- YR.

TABLE A-7

SOLVENT RECOVERY EQUIPMENT SUPPLIERS AND EQUIPMENT CHARACTERISTICS

SUPPLIER	MODEL	EQUIPMENT CAPACITY	COST	TEMP. LIMIT (°F)
Recyclene Products, Inc. 405 Eccles Ave. So.San Francisco, CA 94080 (415) 589-9600	R-2 RS-20 RS-35AF	5 gal/4 hr. 5 - 7 gph (1) 8 - 12 gph (1)	\$ 2,495 \$11,000 \$21,000	< 300 °F
Solvent Distillation Equip. Finish Engineering Co. 921 Greengarden Rd. Erie, PA 16501 (814) 455-4478 (415) 821-4154	LS-15 LS-15V	15 gal/8 hr. 15 gal/8 hr.	\$ 5,895 \$ 9,390	<390 °F <500 °F

TABLE A-8

AQUEOUS WASTE VOLUME REDUCTION SUPPLIER

SUPPLIER	MODEL	EQUIPMENT CAPACITY	COST
D & K Sales EVAP 1433 Lidcombe Ave. So.El Monte, CA 91733 (818) 575-1644	85-E	85 gallon	\$ 1,995
Nordale Fluid Eliminator 990 Xylite Ave., N.E. Minneapolis MN 55434 (603) 668-7111	1000-MS	150 gallon	\$ 8,000 - \$13,000
Wastewater Treatment Systems 440 N. Central Ave. Campbell, CA 95008 (408) 374-3030	-	50 gallon	\$15.000 - \$18,000

---

1. 4 hours per cycle.

WESLEY M. TOY, P.E.
18805 Cox Avenue, Suite 120, Saratoga, CA 95070

Consulting Engineer
California Reg. Ch. 3260
(408) 374-4579

October 29, 1986

FIRM C

Attn:

Subject: Dept. of Health Services (DOHS), RFP 86 - 024
Waste Audit Study on Automotive Repairs

Dear

The enclosed waste audit was performed on the operations of your firm on the above referenced contract with DOHS.

Our conclusions on methods by which you could reduce aqueous and solvent waste generation are given in Section 2. They include installation of solvent recovery equipment with a 3 to 4 year payback and installation of either evaporative or chemical batch treatment with less than a year payback. Both of these changes to your operations look favorable and economic.

Please feel free to discuss these results with me further.

Very truly yours.

Wesley M. Toy

Wesley M. Toy, P.E.

Attachment

WASTE AUDIT - FIRM C

1. GENERAL OPERATION-CHARACTERISTICS

A. Description:

Firm C is an equipment leasing and maintenance service company for parts washing equipment used in the auto repair industry.

B. Size:

700 auto repair facilities serviced in Northern California.

C. Service Provided:

450 hot tanks in service using detergent or alkali cleaning solution.
460 solvent sinks in service using a paraffin based solvent.
50 pressure cleaning chambers (jet spray washers) using detergent or alkali cleaning solution.

D. Raw Materials:

	Quantity Gal/Mo	Quantity Lb/Mo	Generic Description	Hazard Class	UN/NA I.D. Number
Parts Cleaning Solvent Chevron 350	3700	24050	Paraffin Solvent bp 310-370 deg.F	Combustible Liquid	UN 1268
Parts Washing Detergent					
Aluminum-Safeway HT-E-13	-solid-	1500	Alkaline Detergent	None	-
Ferrous-Safeway 9862	-solid-	500	Caust.Soda & Srfactnts.	Corrosive Solid	UN 1759
Carburetor Cleaner 4425 EXSL Chemical	30	294	45% Methylene Chloride & 15% Cresylic Acid	Corrosive Liquid	UN 1760

E. Waste Generated:

	Gal/Mo	Lb/Mo	DOT Shipping Name	Hazard Class	UN/NA I.D. Number
Spent Solvent	2200	16940	Waste Petro.Distillate	Combustible Liquid	UN 1268
Aqueous Detergent & Caustic Waste	2000	17400	Waste Corr.Liquid,N.O.S.	Corrosive Liquid	UN 1760
Carburetor Cleaner	13	127	Waste Cpd.Clng.Liquid	Corrosive Material	NA 1760
Solid Wastes from Aqueous Waste Concentration	<=200	<=5000	Waste Corr.Solid,N.O.S.	Corrosive Solid	UN 1759

F. Equipment Used:

450 hot tanks
460 solvent sinks
50 pressure cleaning chambers

G. Current Disposal Practices:

	Method
Spent Solvent	Monthly pick-up by solvent recycle service for fuel use.
Aqueous Detergent & Caustic Waste	On-site disposal to municipal sewer with: 1) provision for separation of solids 2) current installation and start-up of volume reduction equipment
Carburetor Cleaner	To waste reprocessor stabilized in vermiculite.

H. Material Losses:

	Quantity Gal/Mo	Quantity Lb/Mo	Losses
Parts Cleaning Solvent	1500	16940	Evaporation and spillage (off site)

I. Prioritized Sites of Significant Waste Generation:

Action Priority	Hazard Priority	Waste Type	On-site Source	Waste lb/mo	Manifesting Required?	Criteria for Waste Determination
3	5	Spent Solvent	Solvent Holding Tank	16940	Yes	Solvent,High metals
5	5	Aqueous Detergent & Caustic Waste	As-received hot tank wastes	17400	Yes	High metals
5	5	Oily soil with high metals content	Aqueous waste residue	<=5000	Yes	High metals
2	5	Carburetor Cleaner	As-received waste	127	Yes	Chlorinated solvent

Priority scale: 1 = Low 5 = High

2. WASTE MANAGEMENT OPTIONS

A. General Practice

Firm C provides equipment and maintenance services to clean auto parts. Both aqueous and organic solvents are used to dissolve and suspend grease, oil and dirt residues. Periodic maintenance of leased equipment is based upon:

1. Hot Tanks and Jet Sprays:
   Removal of an average 10 gallons of spent material from a 60 gallon batch of aqueous solution, replenishment with water and recharge with 8 - 10 lb of alkali or detergent compounds.

2. Solvent Sinks:
   Removal of all 7 - 8 gallons of spent solvent solution and replacement of 10 gallons of fresh solvent.

The volume of liquid required in each device to suspend waste materials is dependent upon the type and degree of use, and the frequency of servicing.

The existing pattern of use for hot tanks is primarily on a monthly service basis (75%). Solvent sinks are serviced in the following proportions: 63% monthly, 25% bimonthly, 12% every 3 months. Reduction of volumes generated would be by increasing times between maintenance, but reducing solvent quality.

Since use of a hot tank/solvent sink service is to be encouraged to minimize waste generation, increased periods between servicing is not to be encouraged.

Off Site:

- Drip trays could be provided on solvent sinks to increase recovery of spent solvents.
  -anticipated solvent recovery: 500 gallons per month.
- Provide drip pan/cool down tray for cleaned parts
  -impact: improved repair shop cleanliness.

On Site:

- Repair fractured concrete pad to prevent ground water contamination
- Continue current activities to install aqueous waste volume reduction equipment.
- Provide curbing and containment of run-off wastes from site for processing by waste volume reduction.

B. Specific Management Options:

1. Solvent

- The current method used to dispose of waste solvent solutions by off-site processing for fuel use could be improved by installing on-site solvent recovery equipment. An analysis of the application economics for two types of commercially available solvent distillation devices is shown in Table A-9, Waste Solvent Recovery Options.

  The bases for these evaluations are:
  - 2200 gallons spent solvent processed per month
  - 3800 gallons fresh solvent required (42% user loss rate)
  - Labor charges @ $11.00 per hour to operate equipment
  - Loss of monthly credit of $0.15 per gallon for spent solvent sales
  - Fresh solvent cost of $0.745 per gallon
  - Cost of capital at 6% per annum

The conclusions are:

- Use of an on-site recovery device manufactured by either Recyclene or Solvent Distillation Equipment is economical with a 6 to 9 year payback period of capital costs. This situation exists because no additional tank storage is required, and because of the reasonably high volume processed daily. Additional yearly savings would be on the order of $3,000 to $5,000 per year. Note that for the anticipated 3800 gal/mo. recovery of spent solvent, the payback is 3 to 4 years with a yearly savings of $8,000 to $9,000.
- Anticipated impact:
  Recovery of 2000 gallons per month of spent solvent. Lower solvent material costs.

2. Aqueous or Alkaline Detergent Wastes:

- The current method used to dispose of aqueous wastes is unacceptable. The present installation of 7 aqueous waste evaporation concentrators supplied by D & K Sales may solve this problem. An analysis of the equipment supplied by three equipment suppliers was performed. Each is compared to costs required for Class I disposal of materials. The results are shown in Table A-10, Detergent and Alkali Waste Reduction Options.

The basis for these evaluations are:

- 2000 gallons hot tank and/or jet spray wastes processed per month
- Class I disposal costs of $115 per drum of stabilized waste and $35 per drum of stabilized solid wastes
- Waste volume reduction of 10 to 1
- Labor charges of $11 per hour to operate and maintain equipment
- Cost of capital at 6% per annum

The conclusions are:

- A short payback time of about 2 months was obtained using either of the evaporative waste concentration methods (D & K or Nordale) compared to the use of settling and precipitation methods employed by the "Batchmaster" manufactured by Wastewater Treatment Systems. A 12 to 19 month payback period was obtained with the Batchmaster. All of the 5 models evaluated provided an acceptable breakeven analysis. Initial capital investments varied considerably from $4511 for the D & K Model 250-E or $4990 for two units of the D & K Model 85-E, to $39,000 and $50,500 for the Batchmaster 200 or 50 respectively.

  The D & K units are electrically powered and show subsequently high utility costs ($15,895) compared to the gas-fired Nordale equipment ($3,600). At this point, the Nordale evaporator has not been completely adapted for automotive repair sludges. The Batchmaster has very low utility costs ($680) but chemical costs are higher of course ($5,640).

  Between the D & K Model 250 and the Batchmaster 200 which show the lowest payout times, the D & K unit has fewer cycles required per month, 20 instead of 25. All other units required 33 to 100 cycles per month.

  The evaporative waste concentrating units provide a stabilized sludge for disposal using vermiculite as the stabilization agent. The Batchmaster uses a filter press to dewater the sludge produced. A filter press could be used on the evaporative units also but would increase payback periods by 3 months.

  If capital costs are the major consideration, the D & K Sales evaporative units provide the lowest cost by a substantial margin. The D & K Model 250 also provides the fewest cycles per month (20) with a moderate capacity utilization (63%).
- Anticipated impact:
  Compliance to local municipal sewer discharge codes. Lower off-site disposal costs. Increased equipment and labor costs.

TABLE A-9

WASTE SOLVENT RECOVERY OPTIONS

FIRM C

BASIS: 1 YEAR
$11.00/HR. LABOR RATE
2200 GAL/MO.

ITEM	MANUFACTURER AND MODEL NUMBER RECYCLENE RX-35AF	RECYCLENE RS-35AF	SDE LS-55 II
UNIT COST:	$25,850	$21,000	$14,650
INSTALLATION:	$2.585	$2,100	$1,465
INITIAL SOLVENT CHARGE:	$2,608	$2,608	$2,608
TOTAL CAPITAL COST:	$31.043	$25,708	$18.723
UNIT CHARACTERISTICS:			
UNIT POWER, KW:	4.95	2.5	3.1
DIST.RATE(EFFECTIVE).GPH:	12.67	7.17	6.875
HOURS/CYCLE:	12	24	8
BAG COST,$:	$45.42	$45.42	$0.00
GALLONS/BAG:	760	850	1
WATER USAGE,GPH:	75	75	120
WATER USAGE (CF/YR):	13344	23585	39337
LABOR, HRS/CHANGE:	0.5	0.5	1
LABOR,MAINT.,HR/YR.:	12	12	12
SOLVENT USAGE:			
SOLVENT USED, GAL/YEAR:	26400	26400	26400
% LOSS:	42%	42%	42%
LABOR RATE,$/HR:	$11.00	$11.00	$11.00
OPERATING COSTS ($/YR):			
POWER $ @$0.10/KWH:	$597	$533	$689
BAG COST:	$913	$807	$0
SOLVENT REPLACEMENT:	$8,281	$8.281	$8.281
WATER @ $0.0089/CF:	$119	$210	$350
LABOR:	$685	$621	$3,189
SLUDGE PICKUP(STABILIZED):	$2,137	$2,137	$2,137
TOTAL OPERATING COSTS:	$12,733	$12.589	$14,647
PRESENT SOLVENT COST:	$17,375	$17.375	$17,375
YEARLY COST SAVINGS:	$4.642	$4.786	$2,729
BREAKEVEN @ 6%:	8.5 YR.	6.5 YR.	8.8 YR.

TABLE A-10

DETERGENT AND ALKALI WASTE REDUCTION OPTIONS

BASIS: 1 YEAR
5000 GAL/MO AQUEOUS WASTES
$11.00/HR.LABOR RATE

	MANUFACTURER AND MODEL NUMBER				
	D&K		NORDALE	WASTEWATER TREATMENT	
ITEM	85-E	250-E	FE-150	BATCHMASTER 50	BATCHMASTER 200
UNIT COST:	$3,990	$3,811	$9,500	$18,000	$25,000
FILTER PRESS:				$12,000	$12,000
INSTALLATION:	$1,000	$700	$500	$2,500	$2,500
TOTAL CAPITAL COST:	$4,990	$4,511	$10,000	$32,500	$39,500
UNIT CHARACTERISTICS:					
GALLONS/CHARGE:	85	250	150	50	200
UNIT POWER, KW:	11.78	34.65		0.746	1.119
GAS USAGE,BTU/HR:			125000		
GAS USAGE,THERMS/HR:			1.3		
DISTILLATION RATE,GPH:	4.5	13.2	12		
HRS/CYCLE:	22.19	22.24	15.4	8	8
CYCLES/MO.:	58.8	20.0	33.3	100.0	25.0
% OF MAXIMUM CAPACITY:	185.37%	63.16%	73.61%	118.06%	29.51%
WATER RATE, GPH:	50	150	120		
WATER USAGE,CF/YR:	104978	107321	99088	0	0
LABOR, HRS/CHARGE:	0.5	0.5	0.5	0.5	0.5
JET-SPRAY & HOT TANK,G/MO:	5000	5000	5000	5000	5000
PERCENT REDUCTION:	90%	90%	90%	95%	95%
DISCARD VOLUME, GAL/MO:	500	500	500	250	250
MAINTENANCE MATLS,$/YR:	$100	$100	$238	$230	$370
LABOR,HRS/SLUDGE REM.CYCLE	0.5	0.5	0.5	1	1.5
LABOR,HRS/YR,MAINT.:	10	10	10	24	24
LABOR RATE,$/HR:	$11.00	$11.00	$11.00	$11.00	$11.00
OPERATING COSTS, $/YR:					
POWER $ @$0.10/KWH:	$15,857	$15,895		$680	$255
GAS @ $0.50/THERM:			$3,600		
WATER @ $0.0089/CF:	$934	$955	$882		
CHEMICALS @ $0.094/GAL:				$5,640	$5,640
MAINT MATERIALS:	$100	$100	$238	$230	$370
SLUDGE REM.,(STABILIZED):	$6,686	$6,686	$6,686	$3,916	$3,918
LABOR:					
SLUDGE COLLECTION:	$3,882	$1,320	$2,200	$13,200	$4,950
MAINTENANCE:	$110	$110	$110	$264	$264
CARB.CLNR.PICKUP:	$598	$598	$598	$571	$571
TOTAL OPERATING COSTS:	$28,168	$25,664	$14,314	$24,503	$15,968
WASTE MANAGEMENT COST:	$55,798	$55,798	$55,798	$55,771	$55,771
YEARLY COST SAVINGS:	$27,630	$30,133	$41,484	$31,267	$39,803
BREAKEVEN @ 6%:	2.2 MO.	1.8 MO.	2.9 MO.	19 MO.	12 MO.
BREAKEVEN OVER D&K @ 6%:			5.8 MO.		4+ YR.

APPENDIX 2

CHEMICAL ANALYSIS OF HAZARDOUS WASTES FROM AUTOMOTIVE REPAIRS

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HEAVY METAL CONCENTRATION, PPM (1)

SITE	SAMPLE #	DESCRIPTION	pH	OIL %	Cr			Pb			Zn			As		
					L	S	T	L	S	T	L	S	T	L	S	T
		SOLVENTS														
FIRM A	B	SOLVENT BUCKET	6.0		0.06	0.30	0.36	0.20	0.20	0.4	0.80	2.70	3.5	5.20	7.20	12.4
FIRM B	M	SOLVENT SINK	6.0		<.01	0.20	0.2	0.07	0.30	0.37	0.13	1.61	1.74	7.80	<1	7.8
FIRM C	F	SOLVENT DRUM as Recd.	6.0		0.02	0.40	0.42	0.56	0.17	0.73	0.54	5.80	6.34	5.00	7.20	12.2
FIRM C	H	HOLDING TANK + RESIDUE	6.0		0.60	31.0	31.6	4.70	327	331.	2.80	395	397.	3.60	8.00	11.6
FIRM A	C	CARBURETOR CLEANER	6.8		376	139	515	60.3	0.20	60.5	5.90	5.20	11.1	6.30	7.20	13.5
FIRM B	G	CARBURETOR CLEANER	8.5		85	36.8	121.	44.2	5.00	49.2	9.30	3.40	12.7	5.10	4.80	9.9
FIRM C	I	CARBURETOR CLEANER	9.0		312	522	834	2.40	60.3	62.7	4.80	302	306.	3.20	9.00	12.2
		SOLIDS														
FIRM A	A	SAWDUST ABSORBANT	6.4	-	-	10.0	-	-	111	-	-	18.3	-	-	16.3	-
FIRM C	E	HOT TANK - Dry Resid.	12.5	-	-	17.1	17.1	-	1035	1035	-	348	348	-	12.6	12.6
FIRM C	J	STEAM CLEANING SUMP	10.5	-	-	27.0	27	-	1455	1455	-	5.90	5.9	-	27.0	27
		AQUEOUS														
FIRM A	N	JET SPRAY	9.5	0.349	2.00	2.00	4	2.60	5.10	7.7	4.52	4.90	9.42	4.00	4.40	8.4
FIRM B	K	HOT TANK - Al	12.0	0.340	0.20	0.08	0.28	33.6	82.6	116.	3.70	1.40	5.1	6.40	4.90	11.3
FIRM B	L	HOT TANK - Fe	11.0	0.072	0.30	3.30	3.6	1.00	4.78	5.78	0.50	1.54	2.04	9.90	7.00	16.9
FIRM C	O	HOT TANK - COMPOSITE	12.0	1.860	0.26	13.0	13.2	40.0	70.0	110	5.60	5.40	11	11.0	6.00	17
FIRM B	O	RADIATOR SOLUTION	8.5		0.05	0.20	0.25	0.06	1.20	1.26	0.22	2.50	2.72	<1	1.40	1.4
STANDARD		MUNICIPAL MAX	10.5	0.010			1.7			0.5			1.48			0.3
		SEWER - SVL MIN	5.0													
		MUNICIPAL MAX	10.5	0.015			1.0			0.4			2.60			1.0
		SEWER - SJ MIN	5.0													

L - LIQUID   S - SOLID   T - TOTAL

(1) PPM of metals based upon the total sample taken. Liquid and solid components are additive to obtain total solution concentrations.

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					HEAVY METAL CONCENTRATION, PPM (1)											
	SAMPLE			OIL	Se			Ba			F			Ni		
SITE	#	DESCRIPTION	pH	%	L	S	T	L	S	T	L	S	T	L	S	T
		SOLVENTS														
FIRM A	B	SOLVENT BUCKET	6.0		4.60	6.50	11.1	<1	<1	0	<1	<1	<1	<.1	0.06	0.06
FIRM B	M	SOLVENT SINK	6.0		4.60	4.60	9.2	<1	<1	0	<1	<1	<1	0.08	0.10	0.18
FIRM C	F	SOLVENT DRUM as Recd.	6.0		3.40	6.00	9.4	<1	<1	0	<1	<1	<1	0.02	0.70	0.72
FIRM C	H	HOLDING TANK + RESIDUE	6.0		1.20	4.30	5.5	<1	343	343	<1	<1	<1	0.70	13.0	13.7
FIRM A	C	CARBURETOR CLEANER	6.8		2.80	4.10	6.9	16.2	73.8	90	<1	<1	<1	1.20	1.90	3.1
FIRM B	G	CARBURETOR CLEANER	8.5		3.70	2.60	6.3	39.2	<1	39.2	<1	<1	<1	0.40	0.08	0.48
FIRM C	I	CARBURETOR CLEANER	9.0		<.1	1.71	1.71	19.2	<1	19.2	<1	<1	<1	1.30	46.5	47.8
		SOLIDS														
FIRM A	A	SAWDUST ABSORBANT	6.4	-	-	15.1	-	-	202	-	-	<1	-	-	15.8	-
FIRM C	E	HOT TANK - Dry Resid.	12.5	-	-	5.30	5.3	-	509	509	-	<1	-	-	38.4	38.4
FIRM C	J	STEAM CLEANING SUMP	10.5	-	-	7.20	7.2	-	245	245	-	<1	-	-	24.8	24.8
		AQUEOUS														
FIRM A	N	JET SPRAY	9.5	0.349	1.30	3.90	5.2	2.00	3.30	5.3	<1	<1	<1	0.10	0.20	0.3
FIRM B	K	HOT TANK - Al	12.0	0.340	1.80	3.50	5.3	<1	<1	0	<1	<1	<1	0.30	0.10	0.4
FIRM B	L	HOT TANK - Fe	11.0	0.072	2.50	5.00	7.5	<1	<1	0	<1	<1	<1	0.30	0.20	0.5
FIRM C	D	HOT TANK - COMPOSITE	12.0	1.860	2.90	5.90	8.8	4.00	91.0	95	<1	<1	<1	0.30	0.70	1
FIRM B	O	RADIATOR SOLUTION	8.5		<.1	1.54	1.54	<1	<1	0	<1	<1	<1	0.03	0.10	0.13
STANDARD		MUNICIPAL MAX	10.5	0.010			2.0			1.0			-			0.5
		SEWER - SVL MIN	5.0													
		MUNICIPAL MAX	10.5	0.015			2.0			5.0			10.0			2.6
		SEWER - SJ MIN	5.0													

L - LIQUID S - SOLID T - TOTAL

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(1) PPM of metals based upon the total sample takken. Liquid and solid components are additive to obtain total solution concentrations.

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CHEMICAL ANALYSES OF HAZARDOUS WASTES FROM AUTOMOTIVE REPAIRS

					HEAVY METAL CONCENTRATION, PPM (1)											
	SAMPLE			OIL	Cu			Cd			Ag			Hg		
SITE	#	DESCRIPTION	pH	%	L	S	T	L	S	T	L	S	T	L	S	T
		SOLVENTS														
FIRM A	B	SOLVENT BUCKET	6.0		0.20	0.40	0.6	0.03	0.07	0.1	<.01	0.02	0.02	<.1	2.60	2.6
FIRM B	M	SOLVENT SINK	6.0		0.10	0.59	0.69	<.01	0.04	0.04	<.01	<.01	0	<.1	<.1	0
FIRM C	F	SOLVENT DRUM as Recd.	6.0		0.31	7.68	7.99	0.02	0.18	0.2	<.01	<.01	0	<.1	2.00	2
FIRM C	H	HOLDING TANK + RESIDUE	6.0		11.7	212	223.	0.26	11.0	11.2	<.01	0.22	0.22	<.1	5.20	5.2
FIRM A	C	CARBURETOR CLEANER	6.8		35.1	14.4	49.5	12.6	2.70	15.3	0.02	0.05	0.07	0.60	4.00	4.6
FIRM B	G	CARBURETOR CLEANER	8.5		1.30	0.21	1.51	3.40	0.66	4.06	<.01	<.01	0	0.51	0.80	1.31
FIRM C	I	CARBURETOR CLEANER	9.0		2.60	56.7	59.3	0.70	3.60	4.3	<.01	0.09	0.09	1.40	2.90	4.3
		SOLIDS														
FIRM A	A	SAWDUST ABSORBANT	6.4	-	-	71.7	-	-	1.10	-	-	0.20	-	-	16.6	-
FIRM C	E	HOT TANK - Dry Resid.	12.5	-	-	374	374	-	5.40	5.4	-	0.13	0.13	-	6.00	6
FIRM C	J	STEAM CLEANING SUMP	10.5	-	-	1260	1260	-	12.0	12	-	0.30	0.3	-	14.2	14.2
		AQUEOUS														
FIRM A	N	JET SPRAY	9.5	0.349	7.20	2.80	10	0.18	0.22	0.4	0.02	<.01	0.02	2.10	1.50	3.6
FIRM B	K	HOT TANK - Al	12.0	0.340	1.20	1.10	2.3	0.08	0.14	0.22	0.12	<.01	0.12	4.70	0.84	5.54
FIRM B	L	HOT TANK - Fe	11.0	0.072	0.36	0.47	0.83	0.09	0.05	0.14	0.10	<.01	0.1	6.40	1.90	8.3
FIRM C	D	HOT TANK - COMPOSITE	12.0	1.860	0.50	8.80	9.3	0.10	1.40	1.5	0.10	0.04	0.14	4.70	2.90	7.6
FIRM B	O	RADIATOR SOLUTION	8.5		2.50	2.80	5.3	0.01	0.04	0.05	<.01	<.01	0	1.40	0.56	1.96
STANDARD		MUNICIPAL MAX	10.5	0.010			2.0			0.1			0.2			0.01
		SEWER - SVL MIN	5.0													
		MUNICIPAL MAX	10.5	0.015			2.7			0.7			0.7			0.01
		SEWER - SJ MIN	5.0													

L - LIQUID S - SOLID T - TOTAL

(1) PPM of metals based upon the total sample takken. Liquid and solid components are additive to obtain total solution concentrations.

CARTER ANALYTICAL LABORATORY, INC.

P.O. BOX 865 • LOS GATOS, CA 95031 • (408) 866-1600

REPORT FOR Mr. Wes Toy, P.E.
18805 Cox Ave. Suite 120
Saratoga, Calif. 95930
ANALYSIS NO 4596 DATE 9-22-86
SUBJECT Chemical Analysis Of Automotive Parts Cleaners For Oil And Residual Metals.

A series of sixteen samples has been analyzed for their oil and residual metals concentrations. The oil portions were extracted with a nanograde methylene chloride solvent. The solvent was allowed to evaporate leaving the oil residue which was quantitated by weighing. Those samples which contained filterable solids were separated into two samples for metals analysis. The solids were digested in concentrated nitric acid, filtered and and tested for soluble metals concentrations. The liquid portions were acidified and tested with the other solutions. All of the metal concentrations were measured using an atomic absorption (AA) spectrometer. The fluorides were observed in the residues of the glass containers.

In the following tables the physical and chemical data has been presented in a descriptive format.

Oil Concentrations

A	10.1%
D	1.86%
E	8.32%
J	8.13%
K	.341%
L	.072%
N	.349%

Sample Descriptions			pH
A	Sample 1E	Sawdust	6.4
B	Sample 1C	Transmission cleaner	6.0

We certify the above analysis to be the true result obtained on the described sample(s)

CARTER ANALYTICAL LABORATORY, INC.

by M. Carter Ph.D.
President

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analysis no 4596

C	Sample 1D	Carburetor cleaner	6.8
D	Sample 2A	Hot tank liquid waste	12.0
E	Sample 2B	Hot tank sludge residue dry	12.5
F	Sample 2D	Solvent washer	6.0
G	Sample 3D	Carburetor cleaner	8.5
H	Sample 2E	Solvent waste with residue from holding tank	6.0
I	Sample 2F	Carburetor cleaner	9.0
J	Sample 2G	Sump sludge	10.5
K	Sample 3A	Hot tank Al	12.0
L	Sample 3B	Hot tank Fe	11.0
M	Sample 3C	Solvent sink	6.0
N	Sample 1A	Jet spray	9.5
O	Sample 3E	Radiator solution	8.5

Visual Observations

A 100% brown sawdust

B orange liquid, 1% solids

C black liquid, 10% solids

D black liquid, 1% oil layer on top, 10% solids

E 100% black dirt

F black liquid, 10% solids

G black liquid, oily

H black liquid, 25% solids

I 25% black liquid, 25% solids, 5% oil layer on top

J 100% black dirt, 2 little rubber objects

K black liquid, 1% oil layer on top

analysis no 4596

L brown liquid, 1% oil layer on top, 5% solids

M redish brown liquid, 5% solids

N black liquid, 1% black oil layer on top, 5% solids

O green liquid, 1% black oil layer on top

Element Concentrations In Units Of ppm

	Ni	Cr	Cu	Cd	Pb	Hg
A Solids	15.8	10.0	71.7	1.1	110.8	16.6
B Solids	.06	0.3	0.4	0.07	0.2	2.6
B H_2O	<.01	0.06	0.2	0.03	0.2	<.1
C Solids	1.9	139.	14.4	2.7	0.2	4.0
C H_2O	1.2	376.	35.1	12.6	60.3	0.6
D Solids	0.7	13.	8.8	1.4	70.	2.9
D H_2O	0.3	0.26	0.5	.10	40.	4.7
E Solids	38.4	17.1	373.5	5.4	1035.	6.0
F Solids	0.7	0.4	7.68	0.18	0.17	2.0
F H_2O	.02	.02	.31	.02	.56	<.1
G Solids	.08	36.8	0.21	0.66	5.0	0.8
G H_2O	0.4	85.	1.3	3.4	44.2	0.51
H Solids	13.0	31.0	212.	11.	327.	5.2
H H_2O	0.7	0.6	11.7	0.26	4.7	<.1
I Solids	46.5	522.	56.7	3.6	60.3	2.9
I H_2O	1.3	312.	2.6	0.7	2.4	1.4
J Solids	24.8	27.	1260.	12.	1455.	14.2
K Solids	0.1	0.08	1.1	0.14	82.6	0.84
K H_2O	0.3	0.2	1.2	0.08	33.6	4.7

L Solids	0.2	3.3	.47	.05	4.78	1.9
L H_2O	0.3	0.3	0.36	0.09	1.0	6.4
M Solids	0.1	0.2	.59	.04	.32	<.1
M H_2O	.08	<.01	0.1	<.01	0.07	<.1
N Solids	0.2	2.0	2.8	0.22	5.1	1.5
N H_2O	0.1	2.0	7.2	.18	2.9	2.1
O Solids	0.1	0.2	2.8	.04	1.2	0.56
O H_2O	0.03	.05	2.5	.01	.06	1.4

Element Concentrations In Units Of ppm.

	Zn	Ag	As	Se	Ba	F
A Solids	18.3	0.2	16.3	15.1	202.1	<1
B Solids	2.7	0.02	7.2	6.5	<1	<1
B H_2O	0.8	<.01	5.2	4.6	<1	<1
C Solids	5.2	0.05	7.2	4.1	73.8	<1
C H_2O	5.9	0.02	6.3	2.8	16.2	<1
D Solids	5.4	.04	6.	5.9	91.	<1
D H_2O	5.6	.10	11.	2.9	4.	<1
E Solids	347.4	0.13	12.6	5.3	508.5	<1
F Solids	5.8	<.01	7.2	6.	<1.	<1
F H_2O	.54	<.01	5.	3.4	<1.	<1
G Solids	3.4	<.01	4.8	2.6	<1.	<1
G H_2O	9.3	<.01	5.1	3.7	39.1	<1
H Solids	395.	.22	8.	4.3	343.	<1
H H_2O	2.8	<.01	3.6	1.2	<1.	<1
I Solids	301.5	.09	9.	1.71	<1.	<1

I H_2O	4.8	<.01	3.2	<.1	19.2	<1
J Solids	5.9	0.3	27.	7.2	244.5	<1
K Solids	1.4	<.01	4.9	3.5	<1.	<1
K H_2O	3.7	0.12	6.4	1.8	<1.	<1
L Solids	1.54	<.01	7.	5.0	<1.	<1
L H_2O	0.5	0.1	9.9	2.5	<1.	<1
M Solids	1.61	<.01	<1.	4.6	<1.	<1
M H_2O	0.13	<.01	7.8	4.6	<1.	<1
N Solids	4.9	<.01	4.4	3.9	3.3	<1
N H_2O	4.52	.02	4.	1.3	2.	<1
O Solids	2.5	<.01	1.4	1.54	<1.	<1
O H_2O	.22	<01	<1.	<.1	<1.	<1

The data indicated the presence of a number of samples which were quite high in heavy metals. Two, of the samples contained in excess of 1000 ppm lead. Thus, according to Section 66699 of Article 11, Criteria for Identification of Hazardous and Extremely Hazardous Wastes, found in Title 22, California State Department of Health Code, those two samples would be considered hazardous wastes.

For your reporting information the actual direct atomic absorption readings have been included as an appendix.

Should you have any questions please call. We look forward to serving you again in the near future.

Analytical Methods

Analysis of specific metals per Standard Methods 303a, 303c, 303f, and 304 as referenced below.

REFERENCES FOR APPENDIX 2

Greenberg, A. E. ed., Standard Methods for Examination of Water and Wastewater, 16th ed. American Public Health Assn., American Water Works et al., Washington D.C., 1985

Appendix. Atomic Absorption Readings of the Digested Samples.

	Ni	Cr	Cu	Cd	Pb	Hg
A Solids	4.85	3.06	.22	.35	.34	5.1
B Solids	.05	.22	.32	.06	.18	2.2
B H_2O	<.01	.05	.17	.02	.12	<.1
C Solids	2.14	1.54	.16	2.98	.17	4.4
C H_2O	1.32	4.18	.39	.14	.67	.7
D Solids	.72	.13	8.80	1.37	.70	2.9
D H_2O	.30	.26	.48	.10	.41	4.7
E Solids	.42	.19	4.15	.06	1.15	6.7
F Solids	.57	.34	6.40	.15	.14	1.7
F H_2O	.02	.02	.31	.02	.56	<.1
G Solids	.10	.46	.26	.82	6.22	1.0
G H_2O	.24	.50	.75	2.00	.26	.3
H Solids	.13	.31	2.12	.11	3.27	5.2
H H_2O	.74	.62	.13	.29	5.22	<.1
I Solids	.54	5.80	.63	4.03	.62	3.2
I H_2O	1.56	3.90	3.30	.87	.03	1.8
J Solids	.17	.18	8.40	.08	.97	9.5
K Solids	.14	.12	1.53	.20	1.18	1.2
K H_2O	.37	.27	1.56	.10	.42	5.9
L Solids	.20	3.30	.47	.05	4.78	1.9
L H_2O	.32	.34	.40	.10	1.12	7.1
M Solids	.10	.20	.59	.04	.32	<.1
M H_2O	.06	<.01	.09	<.01	.05	<.1

N Solids	.19	1.78	2.51	.20	4.62	1.4
N H_2O	.10	1.95	7.20	.18	2.93	2.1
O Solids	.14	.22	4.00	.05	1.71	0.8
O H_2O	.03	.05	2.50	.01	.06	1.4

AA Readings

	Zn	Ag	As	Se	Ba	F
A Solids	5.63	.06	5.	4.8	62.	<1
B Solids	2.29	.02	6.	5.4	<1.	<1
B H_2O	.58	<.01	4.	3.5	<1.	<1
C Solids	5.75	.06	8.	4.6	82.	<1
C H_2O	6.55	.02	7.	3.1	18.	<1
D Solids	5.43	.04	6.	5.9	91	<1
D H_2O	5.64	.10	11.	2.9	4.	<1
E Solids	3.86	.15	14.	5.9	565.	<1
F Solids	4.81	<.01	6.	5.0	<1.	<1
F H_2O	.54	<.01	5.	3.4	<1.	<1
G Solids	4.27	<.01	6.	3.3	<1.	<1.
G H_2O	5.46	<.01	3.	2.2	23.	<1
H Solids	3.95	.22	8.	4.3	343.	<1
H H_2O	3.08	<.01	4.	1.3	4.	<1
I Solids	3.35	.10	10.	1.9	<1.	<1
I H_2O	5.98	<.01	4.	<.1	24.	<1
J Solids	3.94	.23	18.	4.8	163.	<1
K Solids	2.02	<.01	7.	5.0	<1.	<1
K H_2O	4.66	.15	8.	2.2	<1.	<1

L Solids	1.54	<.01	7.	5.0	<1.	<1
L H_2O	.55	.12	11.	2.8	<1.	<1
M Solids	1.61	<.01	<1.	4.6	<1.	<1
M H_2O	.10	<.01	6.	3.5	<1	<1
N Solids	4.44	<.01	4.	3.5	3.	<1
N H_2O	4.52	.02	4.	1.3	2.	<1
O Solids	3.58	<.01	2.	2.2	4.	<1
O H_2O	.10	<.01	6.	3.5	<1.	<1

APPENDIX 3

PAYBACK ECONOMICS FOR ON-SITE OPTIONS

APPENDIX 3

WASTE AUDIT - FIRM A
BASIS: 1 YEAR
1 SINK, 10 GAL EA.
$20.00 LABOR RATE

PAYBACK ECONOMICS FOR ON-SITE OPTIONS
SOLVENT RECOVERY

ITEM	MANUFACTURER AND MODEL NUMBER RECYCLENE R2	RECYCLENE RS-20	RECYCLENE RS-35AF	SDE LS-JR	SDE LS-15	SDE LS-15V
UNIT COST:	$2,495	$11,000	$21,000	$2,995	$5,895	$9,390
SINKS:	$350	$350	$350	$350	$350	$700
INITIAL SOLVENT CHARGE:	$17	$17	$17	$17	$17	$17
TOTAL CAPITAL COST:	$2,862	$11,367	$21,367	$3,362	$6,262	$10,107
UNIT CHARACTERISTICS:						
GALLONS/CHARGE:	5	20	50	5	15	15
UNIT POWER, KW:	0.55	1.65	2.5	0.5	1.65	1.65
DISTILLATION RATE, GPH:	1.25	5	7.17	0.625	1.875	1.875
HRS/CYCLE:	5	5.5	24	8	8	8
BAG COST, $:	$15.00	$41.00	$45.42	$0.00	$0.00	$0.00
WATER RATE, GPH:	8	40	75	11.25	30	30
WATER USAGE, CF/YR:	90	124	405	203	180	180
CHARGES/BAG:	5	5	5	1	1	1
LABOR, HRS/CHARGE:	0.33	0.5	0.5	0.6	0.6	0.6
SINK CHARACTERISTICS:						
# OF SINKS:	1	1	1	1	1	1
SOLVENT, GAL/SINK:	10	10	10	10	10	10
% LOSS:	30%	30%	30%	30%	30%	30%
SOLVENT CHANGES/YR:	12	12	12	12	12	12
MAINTENANCE MATLS, $/YR:	$15	$15	$15	$15	$15	$15
LABOR, HRS/SOLVENT CHANGE:	0.33	0.33	0.33	0.33	0.33	0.33
LABOR, HRS/YR/SINK, MAINT.:	4	4	4	4	4	4
LABOR RATE, $/HR:	$20.00	$20.00	$20.00	$20.00	$20.00	$20.00
OPERATING COSTS:						
POWER $ @$0.10/KWH:	$5	$4	$10	$7	$7	$7
WATER @ $0.0089/CF:	$1	$1	$4	$2	$2	$2
BAG COST:	$50	$34	$15	$0	$0	$0
SINK MAINT MATLS:	$15	$15	$15	$15	$15	$15
SOLVENT REPLACEMENT:	$59	$59	$59	$59	$59	$59
LABOR:						
SOLVENT HANDLING, SINKS:	$79	$79	$79	$79	$79	$79
SINK MAINTENANCE:	$80	$80	$80	$80	$80	$80
DISTILLATION LABOR:	$33	$13	$5	$60	$20	$20
SLUDGE PICKUP:	$225	$225	$225	$225	$225	$225
CARB.CLNR.PICKUP:	$98	$98	$98	$98	$98	$0
TOTAL OPERATING COSTS:	$646	$609	$591	$626	$586	$488
INTERSTATE SERVICE COST:	$434	$434	$434	$434	$434	$434
YEARLY COST SAVINGS:	($212)	($175)	($157)	($192)	($152)	($54)
BREAKEVEN @ 6%:	NA	NA	NA	NA	NA	NA

WASTE AUDIT - FIRM B
BASIS: 1 YEAR
10 SINKS, 10 GAL EA.
$8.40 LABOR RATE

APPENDIX 3

PAYBACK ECONOMICS FOR ON-SITE OPTIONS
SOLVENT RECOVERY

	MANUFACTURER AND MODEL NUMBER					
ITEM	RECYCLENE R2	RECYCLENE RS-20	RECYCLENE RS-35AF	SDE LS-JR	SDE LS-15	SDE LS-15V
UNIT COST:	$2,495	$11,000	$21,000	$2,995	$5,895	$9,390
SINKS:	$3,500	$3,500	$3,500	$3,500	$3,500	$4,900
INITIAL SOLVENT CHARGE:	$165	$165	$165	$165	$165	$231
TOTAL CAPITAL COST:	$6,160	$14,665	$24,665	$6,660	$9,560	$14,521
UNIT CHARACTERISTICS:						
GALLONS/CHARGE:	5	20	50	5	15	15
UNIT POWER, KW:	0.55	1.65	2.5	0.5	1.65	2.35
DISTILLATION RATE,GPH:	1.25	5	7.17	0.625	1.875	1.875
HRS/CYCLE:	5	5.5	24	9	8	8
BAG COST,$:	$15.00	$41.00	$45.42	$0.00	$0.00	$0.00
WATER RATE, GPH:	8	40	75	11.25	30	30
WATER USAGE,CF/YR:	901	1239	4054	2027	1802	1952
CHARGES/BAG:	5	5	5	1	1	1
LABOR, HRS/CHARGE:	0.33	0.5	0.5	0.6	0.6	0.6
SINK CHARACTERISTICS:						
# OF SINKS:	10	10	10	10	10	14
SOLVENT, GAL/SINK:	10	10	10	10	10	10
% LOSS:	30%	30%	30%	30%	30%	30%
SOLVENT CHANGES/YR:	12	12	12	12	12	9.29
MAINTENANCE MATLS,$/YR:	$15	$15	$15	$15	$15	$15
LABOR,HRS/SOLVENT CHANGE:	0.33	0.33	0.33	0.33	0.33	0.33
LABOR,HRS/YR/SINK,MAINT.:	4	4	4	4	4	4
LABOR RATE,$/HR:	$8.40	$8.40	$8.40	$8.40	$8.40	$8.40
OPERATING COSTS:						
POWER $ @$0.10/KWH:	$46	$38	$101	$67	$74	$114
WATER @ $0.0089/CF:	$8	$11	$36	$18	$16	$17
BAG COST:	$504	$344	$153	$0	$0	$0
SINK MAINT MATLS:	$150	$150	$150	$150	$150	$210
SOLVENT REPLACEMENT:	$594	$594	$594	$594	$594	$644
LABOR:						
SOLVENT HANDLING,SINKS:	$333	$333	$333	$333	$333	$360
SINK MAINTENANCE:	$336	$336	$336	$336	$336	$470
DISTILLATION LABOR:	$333	$126	$50	$605	$202	$218
SLUDGE PICKUP:	$225	$225	$225	$225	$225	$225
CARB.CLNR.PICKUP:	$385	$385	$385	$385	$385	$0
TOTAL OPERATING COSTS:	$2,913	$2,542	$2,362	$2,712	$2,314	$2,259
INTERSTATE SERVICE COST:	$3,745	$3,745	$3,745	$3,745	$3,745	$3,745
YEARLY COST SAVINGS:	$832	$1,203	$1,382	$1,032	$1,431	$1,486
BREAKEVEN @ 6%:	9.8 YR.	21.9 YR.	NA	8.2 YR.	8.5 YR.	14.7 YR.

APPENDIX 3

WASTE AUDIT - FIRM B
BASIS: 1 YEAR
10 SINKS, 10 GAL EA.
$38.00 LABOR RATE

PAYBACK ECONOMICS FOR ON-SITE OPTIONS
SOLVENT RECOVERY

	MANUFACTURER AND MODEL NUMBER					
ITEM	RECYCLENE R2	RECYCLENE RS-20	RECYCLENE RS-35AF	SDE LS-JR	SDE LS-15	SDE LS-15V
UNIT COST:	$2,435	$11,000	$21,000	$2,995	$5,895	$9,390
SINKS:	$3,500	$3,500	$3,500	$3,500	$3,500	$4,900
INITIAL SOLVENT CHARGE:	$165	$165	$165	$165	$165	$231
TOTAL CAPITAL COST:	$6,160	$14,665	$24,665	$6,660	$9,560	$14,521
UNIT CHARACTERISTICS:						
GALLONS/CHARGE:	5	20	50	5	15	15
UNIT POWER, KW:	0.55	1.65	2.5	0.5	1.65	2.35
DISTILLATION RATE,GPH:	1.25	5	7.17	0.625	1.875	1.875
HRS/CYCLE:	5	5.5	24	8	8	8
BAG COST,$:	$15.00	$41.00	$45.42	$0.00	$0.00	$0.00
WATER RATE, GPH:	8	40	75	11.25	30	30
WATER USAGE,CF/YR:	901	1239	4054	2027	1802	1952
CHARGES/BAG:	5	5	5	1	1	1
LABOR, HRS/CHARGE:	0.33	0.5	0.5	0.6	0.6	0.6
SINK CHARACTERISTICS:						
# OF SINKS:	10	10	10	10	10	14
SOLVENT, GAL/SINK:	10	10	10	10	10	10
% LOSS:	30%	30%	30%	30%	30%	30%
SOLVENT CHANGES/YR:	12	12	12	12	12	9.29
MAINTENANCE MATLS,$/YR:	$15	$15	$15	$15	$15	$15
LABOR,HRS/SOLVENT CHANGE:	0.33	0.33	0.33	0.33	0.33	0.33
LABOR,HRS/YR/SINK,MAINT.:	4	4	4	4	4	4
LABOR RATE,$/HR:	$38.00	$38.00	$38.00	$38.00	$38.00	$38.00
OPERATING COSTS:						
POWER $ @$0.10/KWH:	$46	$38	$101	$67	$74	$114
WATER @ $0.0089/CF:	$8	$11	$36	$18	$16	$17
BAG COST:	$504	$344	$153	$0	$0	$0
SINK MAINT MATLS:	$150	$150	$150	$150	$150	$210
SOLVENT REPLACEMENT:	$594	$594	$594	$594	$594	$644
LABOR:						
SOLVENT HANDLING,SINKS:	$1,505	$1,505	$1,505	$1,505	$1,505	$1,630
SINK MAINTENANCE:	$1,520	$1,520	$1,520	$1,520	$1,520	$2,128
DISTILLATION LABOR:	$333	$126	$50	$605	$202	$218
SLUDGE PICKUP:	$225	$225	$225	$225	$225	$225
CARB.CLNR.PICKUP:	$385	$385	$385	$385	$385	$0
TOTAL OPERATING COSTS:	$5,269	$4,898	$4,718	$5,068	$4,670	$5,187
INTERSTATE SERVICE COST:	$3,745	$3,745	$3,745	$3,745	$3,745	$3.745
YEARLY COST SAVINGS:	($1,525)	($1,153)	($974)	($1,324)	($925)	($1,442)
BREAKEVEN @ 6%:	N/A	N/A	N/A	N/A	N/A	N/A

APPENDIX 3

WASTE AUDIT - FIRM C
BASIS: 1 YEAR
$11.00/HR. LABOR RATE
2200 GAL/MO.

PAYBACK ECONOMICS FOR ON-SITE OPTIONS
SOLVENT RECOVERY

ITEM	MANUFACTURER AND MODEL NUMBER		
	RECYCLENE RX-35AF	RECYCLENE RS-35AF	SDE LS-55 II
UNIT COST:	$25,850	$21,000	$14,650
INSTALLATION:	$2,585	$2,100	$1,465
INITIAL SOLVENT CHARGE:	$2,608	$2,608	$2,608
TOTAL CAPITAL COST:	$31,043	$25,708	$18,723
UNIT CHARACTERISTICS:			
UNIT POWER, KW:	4.95	2.5	3.1
DIST.RATE(EFFECTIVE),GPH:	12.67	7.17	6.875
HOURS/CYCLE:	12	24	8
BAG COST,$:	$45.42	$45.42	$0.00
GALLONS/BAG:	760	860	1
WATER USAGE,GPH:	75	75	120
WATER USAGE (CF/YR):	13344	23585	39337
LABOR, HRS/CHANGE:	0.5	0.5	1
LABOR,MAINT.,HR/YR.:	12	12	12
SOLVENT USAGE:			
SOLVENT USED, GAL/YEAR:	26400	25400	25400
% LOSS:	42%	42%	42%
LABOR RATE,$/HR:	$11.00	$11.00	$11.00
OPERATING COSTS ($/YR):			
POWER $ @$0.10/KWH:	$597	$533	$689
BAG COST:	$913	$807	$0
SOLVENT REPLACEMENT:	$8,281	$8,281	$8,281
WATER @ $0.0089/CF:	$119	$210	$350
LABOR:	$685	$621	$3,189
SLUDGE PICKUP(STABILIZED):	$2,137	$2,137	$2,137
TOTAL OPERATING COSTS:	$12,733	$12,589	$14,647
PRESENT SOLVENT COST:	$17,375	$17,375	$17,375
YEARLY COST SAVINGS:	$4,642	$4,786	$2,729
BREAKEVEN @ 6%:	8.5 YR.	6.5 YR.	8.8 YR.

APPENDIX 3

PAYBACK ECONOMICS FOR ON-SITE OPTIONS
AQUEOUS WASTE VOLUME REDUCTION
BASIS: 1 YEAR

WASTE AUDIT - FIRM A

ITEM	UNIT DESCRIPTION: D&K MODEL 85-E OPTION: BUY JET-SPRAY	D&K MODEL 85-E LEASE JET-SPRAY	NORDALE FE-150 BUY JET-SPRAY	BATCHMASTER 50 BUY JET-SPRAY
UNIT COST:	$1,995	$1,995	$9,500	$30,000
JET SPRAY PURCHASE:	$3,700		$3,700	$3,700
INSTALLATION:	$500	$500	$500	$2,500
TOTAL CAPITAL COST:	$6,195	$2,495	$13,700	$36,200
UNIT CHARACTERISTICS:				
GALLONS/CHARGE:	85	85	150	50
UNIT POWER, KW:	11.78	11.78		0.75
GAS USAGE,BTU/HR:			125000	
GAS USAGE,THERMS/HR:			1.3	
DISTILLATION RATE,GPH:	4.5	4.5	12	
HRS/CYCLE:	22.19	22.19	15.80	8.00
CYCLES/MO.:	1.1	1.1	0.6	1.8
% OF MAXIMUM CAPACITY:	3.34%	3.34%	1.36%	2.13%
WATER RATE, GPH:	50	50	120	
WATER USAGE,CF/YR:	1890	1890	1830	0
LABOR, HRS/CHARGE:	0.5	0.5	0.5	0.5
JET-SPRAY & HOT TANK,G/MO:	90	90	90	90
PERCENT REDUCTION:	90%	90%	90%	95%
DISCARD VOLUME, GAL/MO:	9	9	9	4.5
MAINTENANCE MATLS,$/YR:	$20	$0	$25	$70
LABOR,HRS/SLUDGE REM.CYCLE	0.5	0.5	0.5	1
LABOR,HRS/YR,MAINT.:	4	0	4	12
LABOR RATE,$/HR:	$20.00	$20.00	$20.00	$20.00
OPERATING COSTS, $/YR:				
POWER $ @$0.10/KWH:	$285	$285	$0	$11
GAS @ 0.50/THERM:			$148	
WATER @ $0.0089/CF:	$17	$17	$16	$0
CHEMICALS @ $0.97/GAL:	$432	$0	$432	$1,480
MAINT MATERIALS:	$20	$0	$25	$90
SLUDGE REM.,(SAFE-WAY):	$362	$362	$362	$306
JET-SPRAY LEASE:		$1,271		
LABOR:				
SLUDGE COLLECTION:	$127	$127	$72	$432
MAINTENANCE:	$80	$0	$80	$240
TOTAL OPERATING COSTS:	$1,323	$2,062	$1,135	$2,558
SAFE-WAY COST:	$2,903	$2,903	$2,903	$2,903
YEARLY COST SAVINGS:	$1,580	$841	$1,768	$345
BREAKEVEN @ 6%:	4.5 yr.	3.3 YR.	10.4 YR.	NA

APPENDIX 3

PAYBACK ECONOMICS FOR ON-SITE OPTIONS
AQUEOUS WASTE VOLUME REDUCTION

WASTE AUDIT - FIRM B
BASIS: 1 YEAR
2 HOT TANKS
LABOR RATE: $38/HR.

	MANUFACTURER AND MODEL NUMBER		
ITEM	D&K MODEL 85-E	NORDALE MODEL FE-150	WASTEWATER TREATMENT BATCHMASTER 50
UNIT COST:	$1,995	$9,500	$30,000
HOT TANKS,2 EA.:	$500	$500	$500
INSTALLATION:	$500	$500	$2,500
TOTAL CAPITAL COST:	$2,995	$10,500	$33,000
UNIT CHARACTERISTICS:			
GALLONS/CHARGE:	85	150	50
UNIT POWER, KW:	11.78		0.75
GAS USAGE,BTU/HR:		125000	
GAS USAGE,THERMS/HR:		1.3	
DISTILLATION RATE,GPH:	4.5	12	
HRS/CYCLE:	22.19	15.80	8.00
CYCLES/MO.:	0.2	0.1	0.4
% OF MAXIMUM CAPACITY:	0.74%	0.30%	0.47%
WATER RATE, GPH:	50	120	
WATER USAGE,CF/YR:	420	407	0
LABOR, HRS/CHARGE:	0.5	0.5	0.5
HOT TANK,G/MO:	20	20	20
PERCENT REDUCTION:	90%	90%	95%
DISCARD VOLUME, GAL/MO:	2	2.	1
MAINTENANCE MATLS,$/YR:	$20	$20	$50
LABOR,HRS/HOT TANK CHANGE:	0.5	0.5	0.5
LABOR,HRS/YR,MAINT.:	4	4	8
LABOR RATE,$/HR:	$38.00	$38.00	$38.00
OPERATING COSTS, $/YR:			
POWER $ @$0.10/KWH:	$63	$0	$2
GAS @ $0.50/THERM:		$33	$0
WATER @ $0.0089/CF:	$4	$4	$0
CHEMICALS @ $0.20/GAL:	$48	$48	$48
CHEMICALS @ $0.97/GAL:			$233
MAINT MATERIALS:	$20	$20	$50
SLUDGE REM.,(STABILIZED):	$600	$600	$587
LABOR:			
HOT TANK COLLECTION:	$456	$456	$456
UNIT OPERATION:	$54	$30	$91
MAINTENANCE:	$152	$152	$304
TOTAL OPERATING COSTS:	$1,397	$1,343	$1,772
SAFE-WAY COST:	$2,235	$2,235	$2,235
YEARLY COST SAVINGS:	$838	$892	$463
BREAKEVEN @ 6%:	4 YR.	20.4 YR.	NA

WASTE AUDIT - FIRM C
BASIS: 1 YEAR
2000 GAL/MO AQUEOUS WASTES
$11.00/HR.LABOR RATE

PAYBACK ECONOMICS FOR ON-SITE OPTIONS
AQUEOUS WASTE VOLUME REDUCTION

	MANUFACTURER AND MODEL NUMBER				
	D&K		NORDALE	WASTEWATER TREATMENT	
ITEM	85-E	250-E	FE-150	BATCHMASTER 50	BATCHMASTER 200
UNIT COST:	$3,990	$3,811	$9,500	$18,000	$25,000
FILTER PRESS:				$12,000	$12,000
INSTALLATION:	$1,000	$700	$500	$2,500	$2,500
TOTAL CAPITAL COST:	$4,990	$4,511	$10,000	$32,500	$39,500
UNIT CHARACTERISTICS:					
GALLONS/CHARGE:	85	250	150	50	200
UNIT POWER, KW:	11.78	34.65		0.746	1.119
GAS USAGE,BTU/HR:			125000		
GAS USAGE,THERMS/HR:			1.3		
DISTILLATION RATE,GPH:	4.5	13.2	12		
HRS/CYCLE:	22.19	22.24	15.4	8	8
CYCLES/MO.:	23.5	8.0	13.3	40.0	10.0
% OF MAXIMUM CAPACITY:	74.15%	25.27%	29.44%	47.22%	11.81%
WATER RATE, GPH:	50	150	120		
WATER USAGE,CF/YR:	41991	42929	39635	0	0
LABOR, HRS/CHARGE:	0.5	0.5	0.5	0.5	0.5
JET-SPRAY & HOT TANK,G/MO:	2000	2000	2000	2000	2000
PERCENT REDUCTION:	90%	90%	90%	95%	95%
DISCARD VOLUME, GAL/MO:	200	200	200	100	100
MAINTENANCE MATLS,$/YR:	$100	$100	$238	$230	$370
LABOR,HRS/SLUDGE REM.CYCLE	0.5	0.5	0.5	1	1.5
LABOR,HRS/YR,MAINT.:	10	10	10	24	24
LABOR RATE,$/HR:	$11.00	$11.00	$11.00	$11.00	$11.00
OPERATING COSTS, $/YR:					
POWER $ @$0.10/KWH:	$6,343	$6,358		$272	$102
GAS @ $0.50/THERM:			$1,440		
WATER @ $0.0089/CF:	$374	$382	$353		
CHEMICALS @ $0.094/GAL:				$2,256	$2,256
MAINT MATERIALS:	$100	$100	$238	$230	$370
SLUDGE REM.,(STABILIZED):	$3,365	$3,365	$3,365	$2,257	$2,257
LABOR:					
SLUDGE COLLECTION:	$1,553	$528	$880	$5,280	$1,980
MAINTENANCE:	$110	$110	$110	$264	$264
CARB.CLNR.PICKUP:	$598	$598	$598	$571	$571
TOTAL OPERATING COSTS:	$12,442	$11,440	$6,983	$11,130	$7,800
WASTE MANAGEMENT COST:	$26,998	$26,998	$26,998	$26,971	$26,971
YEARLY COST SAVINGS:	$14,556	$15,557	$20,015	$15,841	$19,171
BREAKEVEN @ 6%:	4 MO.	3+MO.	6 MO.	2.2 YR.	2.2 YR.

APPENDIX 3

WASTE AUDIT - FIRM C
BASIS: 1 YEAR
5000 GAL/MO AQUEOUS WASTES
$11.00/HR.LABOR RATE

PAYBACK ECONOMICS FOR ON-SITE OPTIONS
AQUEOUS WASTE VOLUME REDUCTION

	MANUFACTURER AND MODEL NUMBER				
	D&K		NORDALE	WASTEWATER TREATMENT	
ITEM	85-E	250-E	FE-150	BATCHMASTER 50	BATCHMASTER 200
UNIT COST:	$3,990	$3,811	$9,500	$18,000	$25,000
FILTER PRESS:				$12,000	$12,000
INSTALLATION:	$1,000	$700	$500	$2,500	$2,500
TOTAL CAPITAL COST:	$4,990	$4,511	$10,000	$32,500	$39,500
UNIT CHARACTERISTICS:					
GALLONS/CHARGE:	85	250	150	50	200
UNIT POWER, KW:	11.78	34.65		0.746	1.119
GAS USAGE,BTU/HR:			125000		
GAS USAGE,THERMS/HR:			1.3		
DISTILLATION RATE,GPH:	4.5	13.2	12		
HRS/CYCLE:	22.19	22.24	15.4	8	8
CYCLES/MO.:	58.8	20.0	33.3	100.0	25.0
% OF MAXIMUM CAPACITY:	185.37%	63.16%	73.61%	118.06%	29.51%
WATER RATE, GPH:	50	150	120		
WATER USAGE,CF/YR:	104978	107321	99088	0	0
LABOR, HRS/CHARGE:	0.5	0.5	0.5	0.5	0.5
JET-SPRAY & HOT TANK,G/MO:	5000	5000	5000	5000	5000
PERCENT REDUCTION:	90%	90%	90%	95%	95%
DISCARD VOLUME, GAL/MO:	500	500	500	250	250
MAINTENANCE MATLS,$/YR:	$100	$100	$238	$230	$370
LABOR,HRS/SLUDGE REM.CYCLE	0.5	0.5	0.5	1	1.5
LABOR,HRS/YR,MAINT.:	10	10	10	24	24
LABOR RATE,$/HR:	$11.00	$11.00	$11.00	$11.00	$11.00
OPERATING COSTS, $/YR:					
POWER $ @$0.10/KWH:	$15,857	$15,895		$680	$255
GAS @ $0.50/THERM:			$3,600		
WATER @ $0.0089/CF:	$934	$955	$882		
CHEMICALS @ $0.094/GAL:				$5,640	$5,640
MAINT MATERIALS:	$100	$100	$238	$230	$370
SLUDGE REM.,(STABILIZED):	$6,686	$6,686	$6,686	$3,918	$3,918
LABOR:					
SLUDGE COLLECTION:	$3,882	$1,320	$2,200	$13,200	$4,950
MAINTENANCE:	$110	$110	$110	$264	$264
CARB.CLNR.PICKUP:	$598	$598	$598	$571	$571
TOTAL OPERATING COSTS:	$28,168	$25,664	$14,314	$24,503	$15,968
WASTE MANAGEMENT COST:	$55,798	$55,798	$55,798	$55,771	$55,771
YEARLY COST SAVINGS:	$27,630	$30,133	$41,484	$31,267	$39,803
BREAKEVEN @ 6%:	2.2 MO.	1.8 MO.	2.9 MO.	19 MO.	12 MO.
BREAKEVEN OVER D&K @ 6%:			5.8 MO.		4+ YR.

APPENDIX 3

LOTUS 1-2-3 (TM) TEMPLATE
PAYBACK ECONOMICS FOR EQUIPMENT USED FOR ON-SITE RECYCLING

```
COLUMN:         A [W28]            B [W5]  C [W9]  etc.-------------->
ROW    1 WASTE AUDIT - COMPANY NAME
       2 BASIS: 1 YEAR
       3       WASTE GENERATION RATE, GAL/MO
       4       OTHER CONSTRAINTS
       5                                                      MANUFACTURER AND MODEL NUMBER
       6              ITEM                  MFR       MFR       MFR       MFR       MFR       MFR       MFR
                                            MODEL     MODEL     MODEL     MODEL     MODEL     MODEL     MODEL
       7 ----------------------------       --------- --------  --------  --------  --------  --------  --------
       8                   UNIT COST:        $1,000
       9                INSTALLATION:        $1,000
      10
      11          TOTAL CAPITAL COST:       @SUM(C8..C9) etc>
      12
      13 UNIT CHARACTERISTICS:
      14              GALLONS/CHARGE:            10
      15              UNIT POWER, KW:         10.00
      16          GAS USAGE,BTU/HR:          100000
      17        GAS USAGE,THERMS/HR:              1
      18       DISTILLATION RATE,GPH:            50
      19                  HRS/CYCLE:           0.50
      20                 CYCLES/MO.:          100.0
      21     % OF MAXIMUM CAPACITY:     +C20/(30*24/(C19+C24)) etc.
      22             WATER RATE, GPH:            50
      23           WATER USAGE,CF/YR:   +C26/C14*C19*C22/7.46*12 etc.
      24          LABOR, HRS/CHARGE:            0.5
      25
      26     WASTE GEN: RATE, GAL/MO:          2000
      27           PERCENT REDUCTION:            90%
      28       DISCARD VOLUME, GAL/MO:  +C26*(1-C27) etc.
      29      MAINTENANCE MATLS,$/YR:          $100
      30  LABOR,HRS/SLUDGE REM.CYCLE            0.5
      31         LABOR,HRS/YR,MAINT.:            10
      32
      33              LABOR RATE,$/HR:       $10.00
      34
      35 OPERATING COSTS, $/YR:
      36          POWER $ @$0.10/KWH:   +C$15*C$26*C$27/C$14*C$19*$/KWH*MONTHS PER YR. etc.
      37          GAS @ $0.50/THERM:    +C20*(C19)*12*C17*$/THERM etc.
      38           WATER @ $0.01/CF:    +C23*0.01
      39     CHEMICALS @ $0.10/GAL:
      40            MAINT MATERIALS:          $100
      41   SLUDGE REM.,(STABILIZED):    +C28*12/DRUM VOLUME*(DRUM DISPOSAL COST+DRUM COST)+(PICKUP CHARGE*PIC
      42                      LABOR:
      43          SLUDGE COLLECTION:    +C26/C14*C30*C33*12 etc.
      44                MAINTENANCE:    +C31*C33 etc.
      45
      46      TOTAL OPERATING COSTS:    @SUM(C36..C44) etc.
      47
      48   PRESENT WASTE DISP.COST:
      49
      50        YEARLY COST SAVINGS:    +C48-C46 etc.
      51
      52       BREAKEVEN @ i% (YR.):    +C55
      53                 F/P,i%,N:      +C$11*(1+C$56/365)^(C$55*365)
      54                 F/A,i%,N:      +C$46*(((1+C$56/365)^(C$55*365))-1)/(C$56/365)/365
      55                        N:           0.33
      56                        i:           6.00%
   NOTE: KEEP ADJUSTING N UNTIL F/P=F/A
```

APPENDIX 4

KETTLEMAN HILLS FACILITY
TREATMENT/DISPOSAL RATE SCHEDULE

KETTLEMAN HILLS FACILITY
TREATMENT DISPOSAL RATE SCHEDULE* 'KHRS
EFFECTIVE OCTOBER 1, 1986

1. SOLIDS THAT MAY BE LANDFILLED:

a. Bulk:	
1. Hazardous waste	\$110.00 yd^3
2. Extremely hazardous, restricted and or wastes contaminated with oil solvents equal to or greater than 1000 ppm	\$130.00 yd^3
b. Drummed:	
1. 30 to 55 gallon size	\$ 35.00 drum ←
2. Lab Packs:	
a. 5 gallons size	\$ 35.00 drum
b. 30 gallon size	\$ 75.00 drum
c. 55 gallon size	\$110.00 drum
d. 85 gallon size	\$140.00 drum
3. Empty Drums:	
a. Metal	\$ 15.00 drum
b. Plastic	\$ 25.00 drum

2. LIQUIDS TREATED BY SOLAR EVAPORATION:

Minimum pH of 4.0

a. Bulk Hazardous (Non restricted)	\$ 0.55 gal
b. Bulk Extremely Hazardous	\$ 0.70 gal
c. Drummed (Hazardous & E. H.) - 30 to 55 gal size	\$ 65.00 drum

3. LIQUIDS TREATED BY CHEMICAL STABILIZATION SOLIDIFICATION

a. Bulk - Treated In Bulk (STABILIZATION)	\$ 1.60 gal
b. Bulk - Treated In Conainers (SOLIDIFICATION)	\$ 2.10 gal
c. Drummed Shipments Treated By Stabilization 30 to 55 gallon size	\$115.00 drum ←

4. LIQUIDS ELIGIBLE FOR FUELS PROGRAM: (ON A SPACE AVAILABLE BASIS)

a. Bulk	Quoted case by case
b. Drummed - 30 to 55 gallon size	Quoted case by case

5. NON PCB LIQUIDS TREATED BY CWM S CHICAGO INCINERATOR (F.O.B. K.H.):

a. Bulk	Quoted case by case
b. Drummed - 30 to 55 gallon size	Quoted case by case

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* Please see notes 13.A. through 13.J.

APPENDIX 5

ANTIFREEZE SOLUTION TOXICITY PER LD_{50}

Appendix 5 - Antifreeze Solution Toxicity Per LD_{50}

OF CALIFORNIA—HEALTH AND WELFARE AGENCY GEORGE [illegible]

DEPARTMENT OF HEALTH SERVICES
714/744 P STREET
ACRAMENTO, CA 95814
(916) 324-1807

May 7, 1985

Mr. Jeff Heath
Ventura Environmental Health Department
800 So. Victoria
Ventura, CA 93009

Dear Mr. Heath:

This is in response to your April 3rd telephone call regarding ethylene glycol toxicity. You referred to the letter of September 26, 1984 addressed to Kip Prahl of California Oil Recyclers, Inc. In that letter, we indicated that ethylene glycol waste is not a hazardous waste. We used the oral-rat LD_{50} of 8540 mg/kg as the basis for this judgment.

However, in your telephone call, you informed us that you have found data indicating that ethylene glycol is more toxic to humans than rats and that the LD_{50} for humans fails the DOHS criteria limit of 5000 mg/kg.

Our staff toxicologist, Dr. Richard Sedman, has found data to support your finding. According to Cassarett and Doull's *Toxicology* , 2nd edition, 1980, p. 481, the oral human LD_{50} for ethylene glycol is 1400 mg/kg. This data, along with the DOHS limit of 5000 mg/kg, indicate that ethylene glycol antifreeze waste should be considered a hazardous waste, regardless of any additives.

Thank you for bringing this matter to our attention. If you have any further questions on the above, please feel free to call Bill Quan of my staff at (916) 324-3754.

Sincerely,

David J. Leu

David J. Leu, Ph.D., Chief
Alternative Technology & Policy
Development Section
Toxic Substances Control Division

DJL:BQ:KC:smk

cc: SEE ATTACHED LIST

APPENDIX 6

MATERIAL SAFETY DATA SHEETS

Form Approved
OMB No. 44-R1387

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration REV. 7-9-84

MATERIAL SAFETY DATA SHEET

Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME Safety-Kleen Corporation	**EMERGENCY TELEPHONE NO.** 312/697-8460
ADDRESS *(Number, Street, City, State, and Zip Code)* 655 Big Timber Road, Elgin, IL 60120	
CHEMICAL NAME AND SYNONYMS Mineral Spirits	**TRADE NAME AND SYNONYMS** Safety-Kleen 105 Solvent-MS
CHEMICAL FAMILY Petroleum Hydrocarbon Fraction	**FORMULA** SK Part #6617

SECTION II — HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS		%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS				BASE METAL		
CATALYST				ALLOYS		
VEHICLE				METALLIC COATINGS		
SOLVENTS	99.9+	100	100	FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES	Dye	.003	100	OTHERS		
OTHERS	Anti-Static Additive	1ppm				

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)

SECTION III — PHYSICAL DATA

BOILING POINT (°F.)	310-400°F	SPECIFIC GRAVITY (H_2O=1)	0.775-0.797
VAPOR PRESSURE (mm Hg.)	2mm Hg@ 68°F	PERCENT, VOLATILE BY VOLUME (%)	100%
VAPOR DENSITY (AIR=1)	4.9	EVAPORATION RATE (toluene =1)	0.02
SOLUBILITY IN WATER	Negligible	%Aromatics (total)	Less than 16%
APPEARANCE AND ODOR	Green Clear		

SECTION IV — FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used) 105°F TCC	FLAMMABLE LIMITS	Lel 0.7	Uel 6.0

EXTINGUISHING MEDIA CO_2 foam, dry chemical, water (mist only)

SPECIAL FIRE FIGHTING PROCEDURES None

UNUSUAL FIRE AND EXPLOSION HAZARDS None

(Continued on reverse side)

SECTION V — HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE
100 ppm

EFFECTS OF OVEREXPOSURE
Severe eye irritation - drying of skin - excessive inhalation causes headache, dizziness and nausea. Harmful or fatal if swallowed.

EMERGENCY AND FIRST AID PROCEDURES
EYE CONTACT: flush with water. SKIN CONTACT: wash with mild soap/water, and apply skin cream. INHALATION: remove to fresh air and call a physicial. Apply artificial respiration if necessary in extremes. ORAL: administer plain water--DO NOT INDUCE VOMITING. Call a physician.

SECTION VI — REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	X	Heat, sparks, open flame and fire.

INCOMPATABILITY *(Materials to avoid)* Strong oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS
Normally none--however, incomplete burning may yield carbon monoxide.

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

SECTION VII — SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Catch and collect for recovery as soon as possible. Avoid exposure to sparks, fire or hot metal surfaces.

WASTE DISPOSAL METHOD
Dispose of in accordance with company or local, state or federal regulations. Incinerate under safe conditions.

SECTION VIII — SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION *(Specify type)*
Self-contained breathing apparatus for concentrations above TLV limits.

VENTILATION	LOCAL EXHAUST Normal room ventilations	SPECIAL ----
	MECHANICAL *(General)* ------	OTHER ----

PROTECTIVE GLOVES In case of prolonged contact use protective gloves or barrier cream.

EYE PROTECTION Yes -- normal precautions.

OTHER PROTECTIVE EQUIPMENT

SECTION IX — SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING
Combustible. Keep away from heat sparks and open flame. Use adequate ventilation. avoid long and repeated contact with skin. If clothes are inadvertently saturated with solvent -- do not smoke -- keep away from ignition source. Keep out of reach of children.

Sht 1 of

Form Approved
OMB No. 44-R1387

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

MATERIAL SAFETY DATA SHEET

Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME: Manufactured by: Exsl Chemical for Safeway Chemical

EMERGENCY TELEPHONE NO.: (408) 727-7031

ADDRESS (Number, Street, City, State, and ZIP Code): 630 Walsh Ave. Santa Clara, CA 95050

CHEMICAL NAME AND SYNONYMS: Alkaline Detergent Blend

TRADE NAME AND SYNONYMS: Safeway 9862

CHEMICAL FAMILY: Alkalies/Surfactants

FORMULA: Proprietary

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS	0	N/A	BASE METAL	0	N/A
CATALYST	0	N/A	ALLOYS	0	N/A
VEHICLE	0	N/A	METALLIC COATINGS	0	N/A
SOLVENTS	0	N/A	FILLER METAL PLUS COATING OR CORE FLUX	0	N/A
ADDITIVES Surfactants	2	N/A	OTHERS	0	N/A
OTHERS Caustic Soda	75	N/A			

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
This is a highly Alkaline material. Do not mix with acids		
or oxidizers. Exothermic cheat releasing reaction may occur.		
Treat as Sodium Hydroxide (lye)		

SECTION III - PHYSICAL DATA

BOILING POINT (°F.)	N/A	SPECIFIC GRAVITY (H_2O=1)	N/A
VAPOR PRESSURE (mm Hg.)	N/A	PERCENT, VOLATILE BY VOLUME (%)	0
VAPOR DENSITY (AIR=1)	N/A	EVAPORATION RATE (________ =1)	
SOLUBILITY IN WATER	Complete		

APPEARANCE AND ODOR: Coarse white powder, bland odor

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used) N/A	FLAMMABLE LIMITS	Lel	Uel

EXTINGUISHING MEDIA: Will not support combustion

SPECIAL FIRE FIGHTING PROCEDURES: N/A

UNUSUAL FIRE AND EXPLOSION HAZARDS: N/A

(Continued on reverse side)

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (Air) 2mg/M^3 for 15 minutes

EFFECTS OF OVEREXPOSURE Corrosive burns to all body tissue in contact

EMERGENCY AND FIRST AID PROCEDURES Flush affected area with lots of water. Mild acids (vinegar, citric) may help to arrest burning. Seek medical attention.

SECTION VI - REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	x	Mixing with acids or oxidizers

INCOMPATABILITY *(Materials to avoid)* Acids, oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS N/A

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	x	

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Sweep up carefully where possible. Flush area with water, neutralize with acid.

WASTE DISPOSAL METHOD Dilute with water, then neutralize with acid. Consult appropriate authorities.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION *(Specify type)* Dust Filter

VENTILATION	LOCAL EXHAUST Adequate	SPECIAL
	MECHANICAL *(General)*	OTHER

PROTECTIVE GLOVES Recommended	EYE PROTECTION Recommended

OTHER PROTECTIVE EQUIPMENT Rubber Apron

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Keep containers closed tightly. Protect from moisture. Wash after use

OTHER PRECAUTIONS Empty containers may contain hazardous residues.

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

Form Approved
OMB No. 44-R1387

MATERIAL SAFETY DATA SHEET

Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME Safe-Way Chemical Co.	**EMERGENCY TELEPHONE NO.** (408) 292-9289
ADDRESS *(Number, Street, City, State and ZIP Code)* 509 Stockton Ave., San Jose, CA. 95110	
CHEMICAL NAME AND SYNONYMS Alkaline Detergent Blend	**TRADE NAME AND SYNONYMS** Safeway HT-E-13
CHEMICAL FAMILY Alkaline Detergent blend	**FORMULA** Proprietary

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS	0	0	BASE METAL	0	
CATALYST	0	0	ALLOYS	0	
VEHICLE	0	0	METALLIC COATINGS	0	
SOLVENTS	0	0	FILLER METAL PLUS COATING OR CORE FLUX	0	
ADDITIVES	0	0	OTHERS Alkaline Detergent	-	-
OTHERS Alkaline Detergent	-	-			

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
Do not mix with strong acids		

SECTION III - PHYSICAL DATA

BOILING POINT (°F.)	Solid	SPECIFIC GRAVITY ($H_2O=1$)	
VAPOR PRESSURE (mm Hg.)	-	PERCENT, VOLATILE BY VOLUME (%)	
VAPOR DENSITY (AIR=1)	-	EVAPORATION RATE (________ =1)	
SOLUBILITY IN WATER	Complete		
APPEARANCE AND ODOR	Off white powder, no odor		

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used) N/A	FLAMMABLE LIMITS N/A	Lel	Uel
EXTINGUISHING MEDIA N/A			
SPECIAL FIRE FIGHTING PROCEDURES N/A			
UNUSUAL FIRE AND EXPLOSION HAZARDS N/A			

(Continued on reverse side)

SECTION V · HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE -0-

EFFECTS OF OVEREXPOSURE -0-

EMERGENCY AND FIRST AID PROCEDURES Treat as an alkali detergent burn.

SECTION VI · REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID Do not mix with strong acids or oxidizers
	STABLE	X	

INCOMPATABILITY *(Materials to avoid)* Strong acids

HAZARDOUS DECOMPOSITION PRODUCTS None

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	None

SECTION VII · SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Treat as an alkaline detergent spill, flush area with water.

WASTE DISPOSAL METHOD Dilute with water

SECTION VIII · SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION *(Specify type)* None required

VENTILATION	LOCAL EXHAUST None required	SPECIAL None
	MECHANICAL *(General)*	OTHER
PROTECTIVE GLOVES Required		EYE PROTECTION Required

OTHER PROTECTIVE EQUIPMENT

SECTION IX · SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

none

OTHER PRECAUTIONS

none

Sht 1 of

Form Approved B
OMB No. 44-R1387

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration Rev. 3-16-83

MATERIAL SAFETY DATA SHEET

Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME Safety-Kleen Corporation	EMERGENCY TELEPHONE NO. 312/697-8460
ADDRESS (Number, Street, City, State, and Zip Code) 655 Big Timber Road, Elgin, IL 60120	
CHEMICAL NAME AND SYNONYMS Organic Solvents	TRADE NAME AND SYNONYMS Immersion Cleaner & Carburetor &
CHEMICAL FAMILY	FORMULA Cold Parts Cleaner #609 P/N 6631

SECTION II — HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	SOLVENTS	%	TLV (Units)
			Cresylic Acids	11.9	5ppm (ski
Non-aqueous Phase ⟶			Sodium Soap of Tall Oil	7.5	----
			Chlorinated Solvent (Methylene Chloride)	31.9	200ppm
			Chlorinated Solvent (Ortho-dichlorobenzene)	31.6	50ppm
Aqueous Phase ⟶			Additives: Complex Amines	0.4	----
			Water	16.7	----

Hazardous Mixtures of Other Liquids, Solids, or Gases

NOTE: This product is a "two-phase" system -- consisting of an upper moderately alkaline aqueous (water) layer (20 vol%) and a lower non-aqueous (solvent) layer (80 vol%)

SECTION III — PHYSICAL DATA

BOILING POINT (°F.)	102-395°F	SPECIFIC GRAVITY ($H_2O=1$)	1.1900
VAPOR PRESSURE (mm Hg.)	Water	PERCENT, VOLATILE BY VOLUME (%)	80%
VAPOR DENSITY (AIR=1)	Water	EVAPORATION RATE (________ =1)	
SOLUBILITY IN WATER	Miscible in all proportions		
APPEARANCE AND ODOR	Clear, dark, amber liquids-aromatic odor--two-phase liquid system (two distinct phases or layers)		

SECTION IV — FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used) Non-flammable	FLAMMABLE LIMITS N.A.	Lel	Uel

EXTINGUISHING MEDIA
N.A.

SPECIAL FIRE FIGHTING PROCEDURES
Although product is non-flammable, open flames, welding arcs, or other high temperature sources can cause product decomposition. This composition can yield hydrogen chloride and/or phosgene.

PAGE (1)

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Rev. May 72

SECTION V — HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE
20 ppm

This refers to the solvent portion only. The solvent portion is blanketed with a mildly alkaline water layer which serves as an evaporation retarder and minimizes fumes and vapors from the solvent portion.

EFFECTS OF OVEREXPOSURE

Severe eye irritation -- "burning of skin" -- excessive inhalation causes headache, dizziness and nausea.

EMERGENCY AND FIRST AID PROCEDURES

EYE CONTACT: Flush with copious amounts of water and call a physician.

SKIN CONTACT: Wash with mild soap and water and/or baking soda water. Then apply skin cream.

INHALATION: Remove to fresh air and call a physician; apply artifical respiration if necessary in extreme cases. If ingested, administer plain water; do not induce vomiting -- call a physician.

SECTION VI — REACTIVITY DATA

STABILITY	**UNSTABLE**		**CONDITIONS TO AVOID** Avoid smoke from any combustion of product.
	STABLE	X	

INCOMPATABILITY *(Materials to avoid)*

HAZARDOUS DECOMPOSITION PRODUCTS
Normally none--however, incomplete burning may yield carbon monoxide. In addition,. open decomposition can yield hydrogen chloride and or phosgene.

HAZARDOUS POLYMERIZATION			
	WILL NOT OCCUR	X	

SECTION VII — SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Absorb spill with sawdust or oil absorbent or soda ash. Catch and collect for recovery as soon as possible. Further flushing and cleaning with a weak alkaline solution (soda ash, baking soda, caustic soda) will aid in neutralizing cresylic acid from the spill.

WASTE DISPOSAL METHOD
Dispose of in accordance with company or local, state and federal regulations.

SECTION VIII — SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION *(Specify type)*
Self-contained breathing apparatus for concentrations above TLV limits.

VENTILATION	**LOCAL EXHAUST** Yes	**SPECIAL** ----
	MECHANICAL *(General)* ----	**OTHER** ----

PROTECTIVE GLOVES rubber gloves	**EYE PROTECTION** chemical face shield: goggles

OTHER PROTECTIVE EQUIPMENT
Rubber apron to protect skin and clothing. Use protective barrier skin cream.

SECTION IX — SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING
Keep away from heat, sparks and open flame. Use adequate ventilation. Avoid contact with skin and eyes.

OTHER PRECAUTIONS
If cleaner contacts clothing, change clothes or wash off excess immediately to avoid possible skin irritation. Although product is non-flammable, open flames, welding arcs or other high temperature sources can cause product decomposition. This decomposition can yield hydrogen chloride and/or phosgene.

APPENDIX 7

VENDOR LITERATURE

Safe-Way Chemical Co.

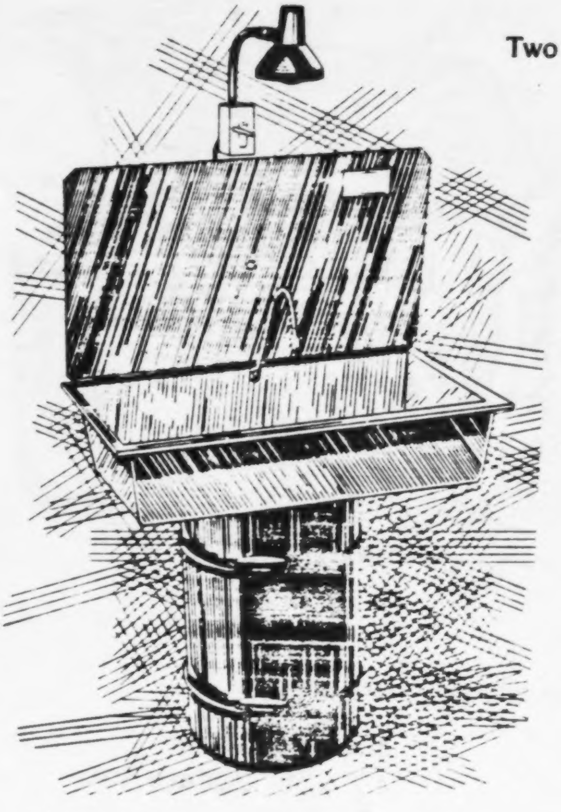
909 Stockton Avenue
San Jose, California 95110
(408) 292-9289

Solvent Parts Washers

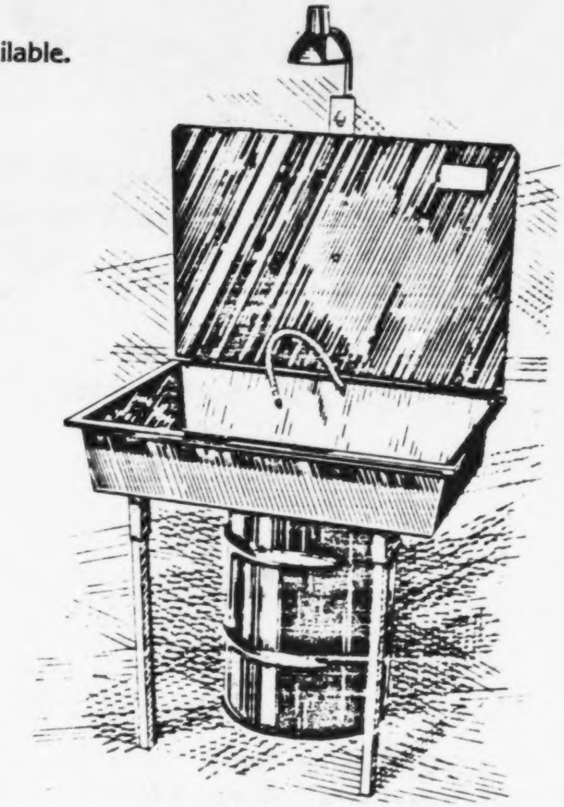
1. Cut your costs with a lease and service program.
2. Furnish everything needed to maintain your unit. We provide the solvent, wash the tray, and haul away the sludge and used solvent for environmentally legal disposal and recycling.
3. Meets all OSHA and local Fire Dept. standards.
4. Class II solvents are used and a safety link is provided which closes the safety lid in case of fire.

Class II solvent is used as the cleaning agent. This is a combustible but non-flammable material.

Two sizes available.



22 gallon
Sink dimensions
20" x 34" x 7" deep

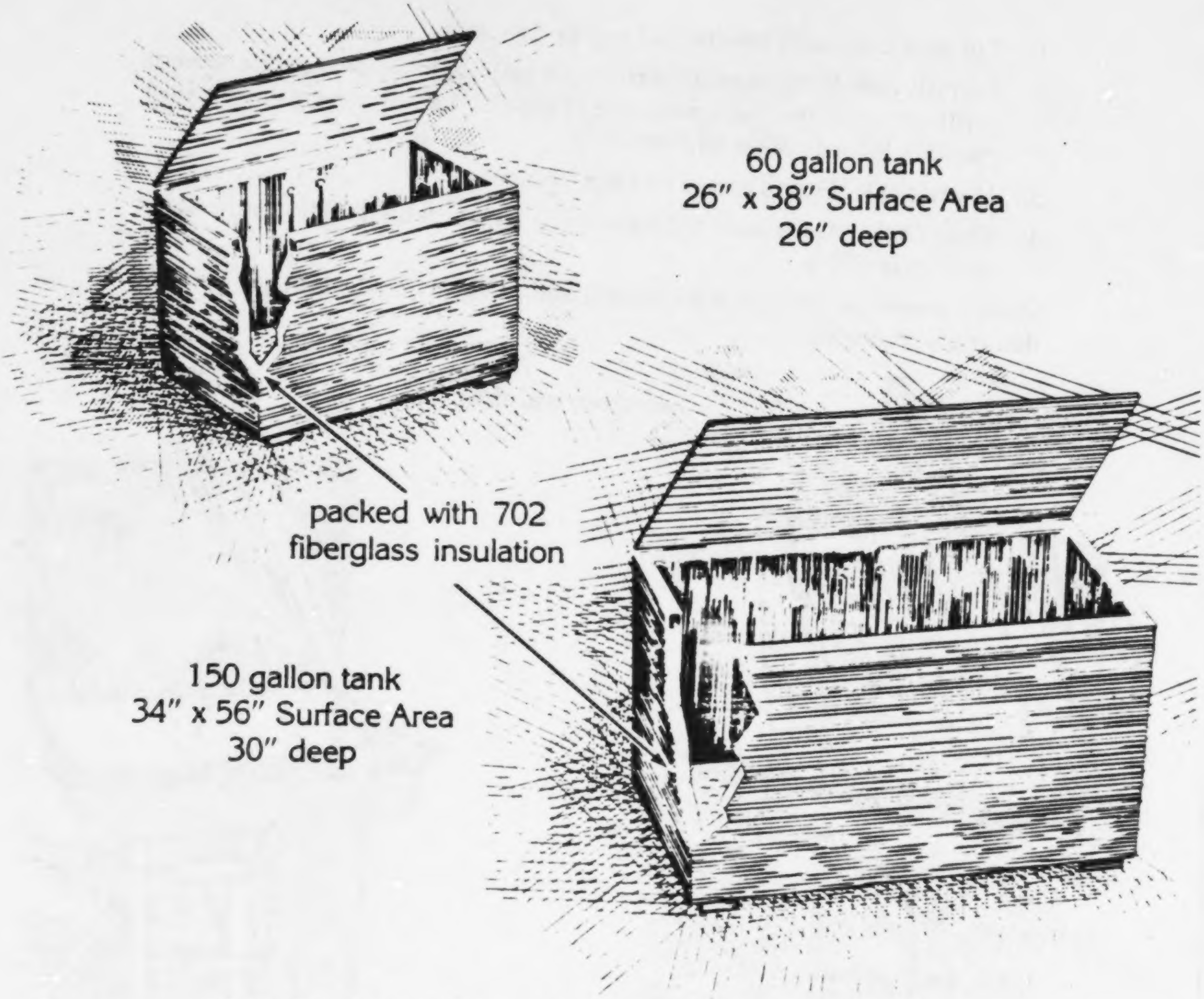


30 gallon
Sink dimensions
26" x 34" x 7" deep

Safe-Way Chemical Co.

909 Stockton Avenue
San Jose, California 95110
(408) 292-9289

Safe-Way Hot Tanks



60 gallon tank
26″ x 38″ Surface Area
26″ deep

packed with 702
fiberglass insulation

150 gallon tank
34″ x 56″ Surface Area
30″ deep

Safe-Way hot tanks are also available in larger sizes.

250 gallon tank
40″ x 56″ Surface Area
36″ deep

400 gallon tank
40″ x 56″ Surface Area
42″ deep

Agitation and filtration options can be ordered with the 150, 250, and 400 gallon tanks. Safe-Way Chemical can provide custom-tanks and service as well. Hoists available upon request.

Safe-Way Chemical Co.
909 Stockton Avenue
San Jose, California 95110
(408) 292-9289

Pressure Cleaning Chamber

The fastest and most ecomonical method for cleaning parts without scrubbing. Safe-Way Chemical pressure cleaning chamber is a fully automatic spray cleaning system.

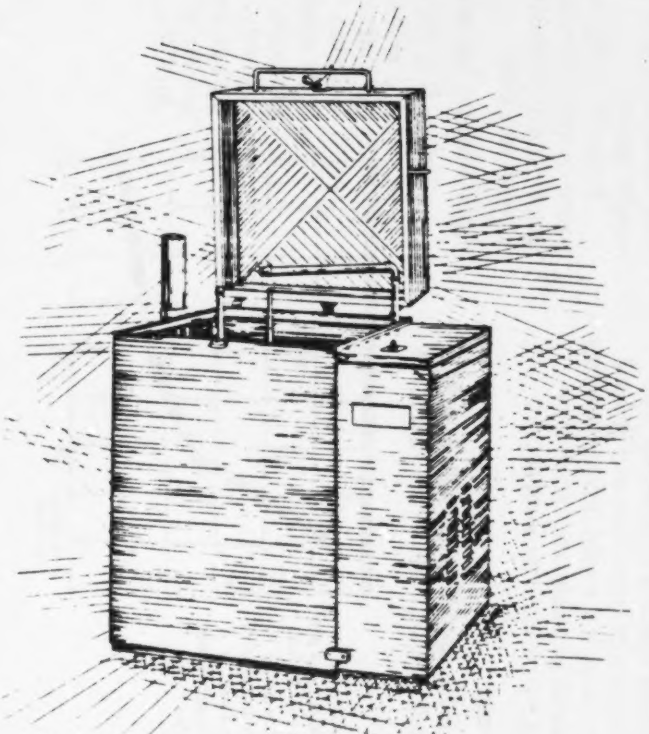
Specifications

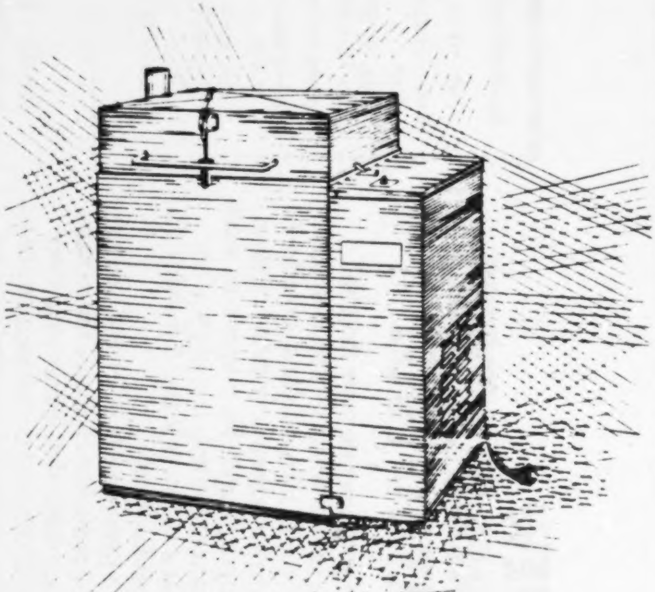
Outside Dimensions

46″ high
39″ wide
28″ deep

220 V power required
48 gallons
gas fired

4 part basket: 26″ diameter
cleaning chamber: 25″ high
Work area tray: 34″ diameter
Work capacity height: 28″ diam.





Larger models available upon special request. They are 60″ high, 57″ wide, and 45″ deep.

DO NEW EPA REGULATIONS APPLY TO YOU?

Yes, if you generate more than half a drum a month of waste solvent. You must now comply with EPA manifest procedures; every drum that leaves your shop has to be labeled and registered. No matter how much you pay someone to take it away, you are liable if that drum **ever** leaks. *A liability that can cost your business.*

With a Recyclene R-2 Solvent Recovery System you reduce or eliminate the amount of hazardous waste that leaves your shop. Reducing liability and compliance problems. That's because material recycled on your premises is exempt from State and Federal regulations. And, if the solid residue qualifies as non-hazardous waste, you can dispose of it through your trash removal service.

Easy-to-use

The R-2 is simple to operate. You just load in used solvent, close the lid, and press the start button. In a few hours, 95% of your solvent is recovered, leaving a solid residue behind.

It installs easily, too, needing no special power or water hook-ups and very little space. And its modular componentry makes for easy servicing.

Save Money, Increase Profits

With an R-2, you reclaim 99.5% pure, reusable material from used solvent for as little as 35¢ a gallon. Compare that with new solvent at $4 a gallon, plus disposal costs. Or paying a solvent reclaimer to haul away your used solvent, plus $2 a gallon for returning recycled solvent of unknown quality.

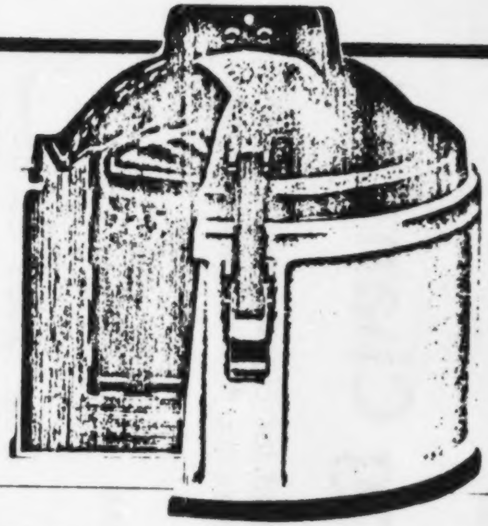
An R-2 recovers your investment in less than 18 months, and then the real savings begin!

Safety is Number 1

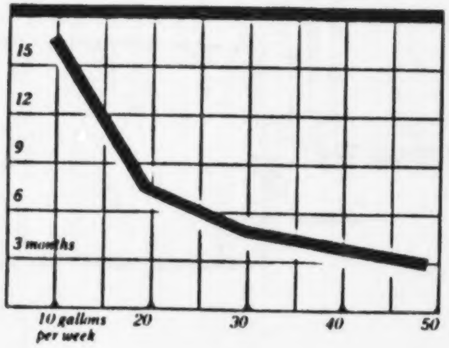
At Recyclene, safety is our first concern. The R-2's unique no-gasket design (patent pending) prevents flammable vapors from escaping during the recovery process. Further, low-voltage microprocessor controls in explosion-proof boxes eliminate the possibility of dangerous sparking; adding up to the safest solvent recovery system available.

Specifications:

Weight: 69 lbs.
Boiler Capacity: 5 gal.
Voltage AC 50/60 Hz: 115 volts
Current: 9.6 amps
Cooling water flow: 8 GPH
Cooling water pressure: 50-100 PSI
Heater: 1100 watts
Typical purity: 99%
Typical yield: 95%
Maximum solvent boiling point: 380°F
Patented disposable bag to line boiler
No rotating mechanical parts
One year warranty


Stainless Steel Boiler and Heat Exchange Condenser
U.L. Approved Explosion Proof Electrical Components
Factory Set Control Thermostats
Three LED Indicators
Auto-Cycle/ Auto Shutdown

With a Recyclene R-2, your investment payback can be under a year. (Schedule at right based on cost of $150 per drum and hauling cost of $75 per drum. Economics vary depending on these specifics.)



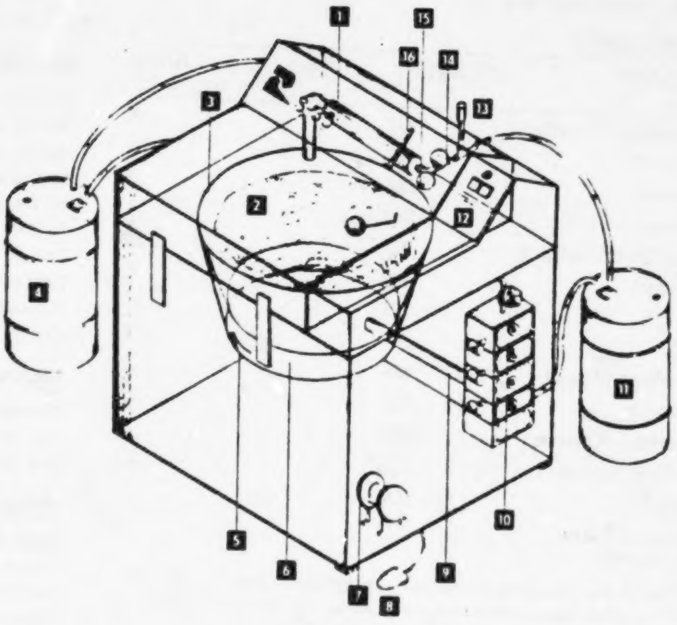
Recyclene Products, Inc.

405 Eccles Avenue
South San Francisco, CA 94080
(415) 589-9600

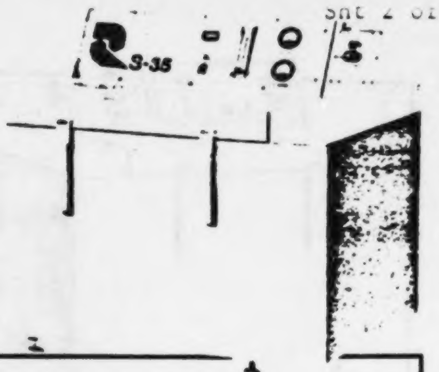
RECYCLENE RS-35 SOLVENT RECOVERY SYSTEM

- The RS-35 is a cost effective way to reduce your hazardous waste problems. Utilizing a patented design, the RS-35 allows you to purify (up to 99.5%) flammable and non-flammable solvents on-site safely and easily (as easy to operate as a washing machine). The RS-35, Recyclene's mid-production model, can usually pay for itself in less than a year if you generate 6 drums per month of waste solvent.
- Fast payback–usually less than one year.
- Reduces EPA liability–reclaims hazardous waste.
- Simple to clean–patented disposable liner.
- Easy to operate–push button control and gauges.
- Safe to use–multiple shutdown controls and lid lock.
- Multiple solvent applications–boiling points up to 400°F.
- Explosion-proof construction–designed to meet NFPA specifications.
- Optional automatic refill–for continuous operation.
- Auto-quench and cooldown–activated when all solvent is distilled.

1. Shell and Tube Condenser
2. Solvent Liner (Nylon or Teflon)
3. Teflon Gasket Seal
4. Dirty Solvent Drum
5. Oil-Immersed Rapid Cooling System
6. Stainless Steel Double Boiler
7. Air-Operated Pump for Autofill
8. Pneumatic Lid Foot Pedal
9. Oil-Immersed Resistance Heater
10. Multiple System Thermostats (Explosion-proof):
    a. Vapor
    b. Condenser
    c. Boiler
    d. Lid Interlock
    e. Safety
11. Clean Solvent Drum
12. On/Off Controls and "Cycle On" Light Panel
13. Breather Vent
14. Vapor Temperature Gauge
15. Oil Temperature Gauge
16. Water Flow Meter



RS-35



RECYCLENE EQUIPMENT SPECIFICATIONS

DIMENSIONS

Width	51 in.
Depth	52 in.
Maximum height	51 in.
Weight, uncrated	804 lbs.
Weight, crated	1044 lbs.
Boiler capacity	35 gal.

UTILITIES

Voltage AC 50/60 Hz	240 volts
Current	21 amps
Cooling water flow	75 GPH
Maximum cooling water temperature	70°F
Water temperature increase	30°F
Cooling water pressure	50-100 PSI
Compressed air pressure	80-100 PSI
Drain	OPEN

PERFORMANCE

Typical warm-up time	1.5 hrs.
Typical purity	99%
Typical yield	95%
Maximum solvent boiling point	400°F
Maximum contaminant	30%

PROCESS RATES*

SOLVENT	BOILING PT. (°F)	GALLONS PER HOUR AFTER WARM-UP
Methylene Chloride	104	9
Freon TF	118	18
Acetone	134	10
Methanol	150	5
1,1,1 Trichloroethane	162	12
Ethanol	170	6
M.E.K.	175	11
IPA	180	7
Trichloroethylene	189	11
Toluene	232	12
Perchloroethylene	250	11
N-Butyl Acetate	255	13
Xylene	290	12
Mineral Spirits (Stoddard)	375	8

*The above data is estimated for pure solvents only. Actual rates will be lower depending on the percentage of and type of contaminants in the solvent, supply voltage and batch size.

CONSTRUCTION

Boiler	Stainless steel
Heat exchange condenser	Alloy
Immersed heater	5000 watts
Heating medium	Proprietary, low viscosity, long-life heat transfer fluid
Electrical components	Explosion-proof–meets highest standards NFPA Class 1 Division 1, Group D

INSTRUMENTATION

Oil temperature gauge	Type J Thermocouple 30-600°F
Vapor temperature gauge	Type J Thermocouple 30-600°F
Water flow meter	0-100 GPH
Control thermostats	SPST snap acting control 0-450°F

SAFETY FEATURES

Automatic cycle shutdown at power interruption

Automatic cycle cooldown when solvent has distilled

In-line fuses

Lid interlock until cooldown achieved

U.L. listed components

Cycle "ON" light

Vacuum vent

Designed to shut down if:
- Power failure
- Water flow interruption
- Boiler overheat
- Excessive water temperature
- Oil level deficiency

ADDITIONAL FEATURES

Patented disposable bag to line boiler
Totally immersed cooling coil
Special industrial insulation
Stainless steel or teflon wetted parts
No rotating mechanical parts
Unit levelers
Pneumatic lift for lid
Low water consumption
Stainless steel fittings
One year warranty

LOCATION FOR INSTALLATION

Mandatory to conform to NFPA Class 1, Div. 1, Group D.
May be non-hazardous if solvents are non-flammable.
See NFPA Codes.

OPTIONAL AUTOFILL SYSTEM

Dual diaphragm pump
Teflon seals
Self priming pump
Secure drum connectors

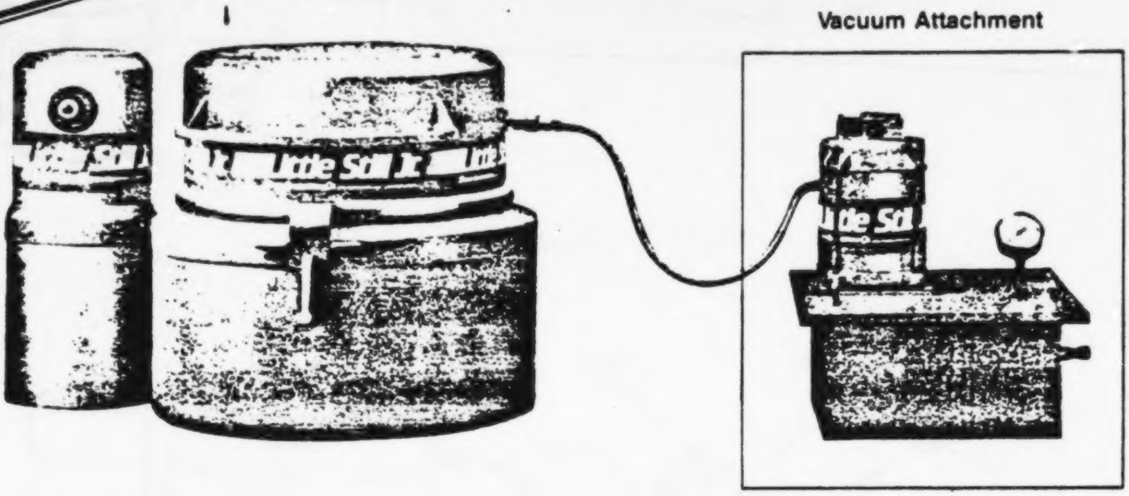
Air logic controls
Automatic boiler feed
Teflon flow lines

Recyclene
Products, Inc. © 1985 Recyclene Products, Inc. 405 Eccles Ave., South San Francisco, CA 94080 (415) 589-9600

Solvent
Distillation
Equipment

Model LS-Jr.†
Vacuum Attachment

Now reclaim high-boiling solvents
New JetVac distillation technology



Capabilities

- Model LS-Jr.V distills 3-5 gallons (11-19 liters) per shift
- Processes solvents with boiling points up to 500°F (260°C) such as mineral spirits, Stoddard solvent, kerosene and Varsol

Specifications

Height:	17 inches	43 cm
Width:	15 inches	38 cm
Depth:	22 inches	56 cm
Weight:	80 pounds	36 kg

Features

- Retrofitable to existing LS-Jr.
- Allows either vacuum or atmospheric distillation
- Minimal operator involvement
- Unique JetVac pump design
- Achieves up to 28 inches (71 cm) mercury vacuum
- Explosionproof electricals meet NEMA 7 (Class I, Division 1, Group D) standards
- Discharges to atmosphere
- One-switch operation
- Easy-to-read vacuum gauge
- Vacuum adjustable to 28 inches mercury

Principles

The LS-Jr. V utilizes breakthrough technology to reclaim higher-boiling solvents. A unique vertical solvent pump and JetVac are immersed in a single reservoir and used to create a vacuum in the distillation unit.

Solvent in the reservoir tank is circulated by the solvent pump through the high-velocity JetVac. This high-speed circulation produces a vacuum in the distillation unit. A cooling coil in the reservoir tank maintains solvent temperature. As additional solvent is recovered and cooled, it is gravity-fed from the vacuum unit to a 5-gallon distillate pail.

Utility Requirements

- 115V, single phase, 60 Hz, 4 amps
- 1/10 to 1/4 GPM cooling water

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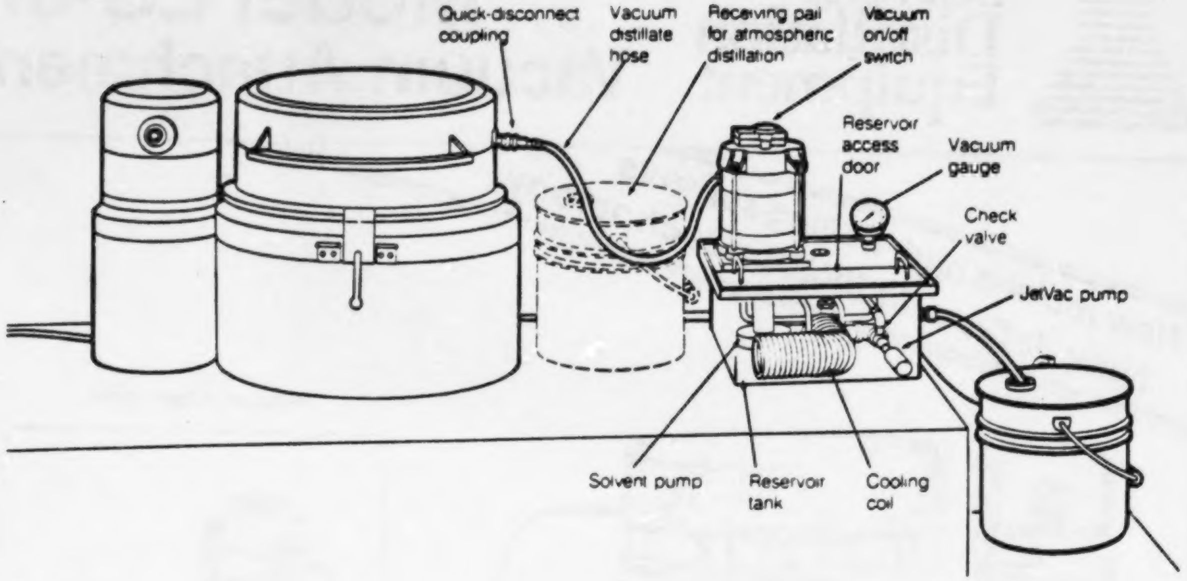
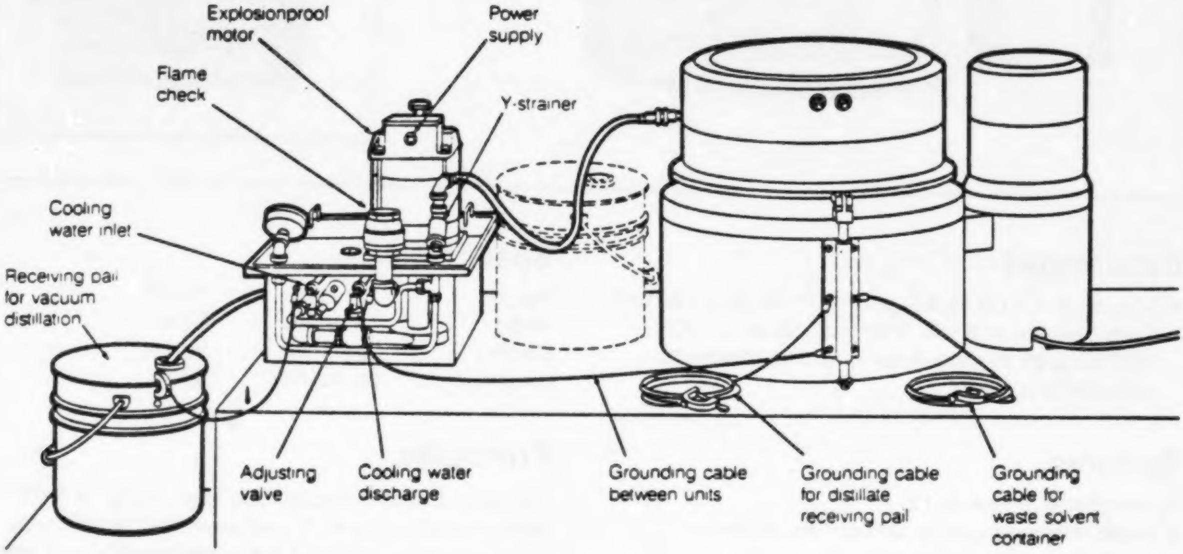
† U.S. Patent 4,488,933


Quick-disconnect coupling
Vacuum distillate hose
Receiving pail for atmospheric distillation
Vacuum on/off switch
Reservoir access door
Vacuum gauge
Check valve
JetVac pump
Solvent pump
Reservoir tank
Cooling coil

Front View


Explosionproof motor
Power supply
Flame check
Y-strainer
Cooling water inlet
Receiving pail for vacuum distillation
Adjusting valve
Cooling water discharge
Grounding cable between units
Grounding cable for distillate receiving pail
Grounding cable for waste solvent container

Rear View

LS-Jr. and Vacuum Attachment

FINISH ENGINEERING Co.™

Finish Company, Inc.
921 Greengarden Road • Erie, Pennsylvania 16501-1591 U.S.A.
Phone 814/455-4478 • TWX 510-696-6816

F86 209 GPS

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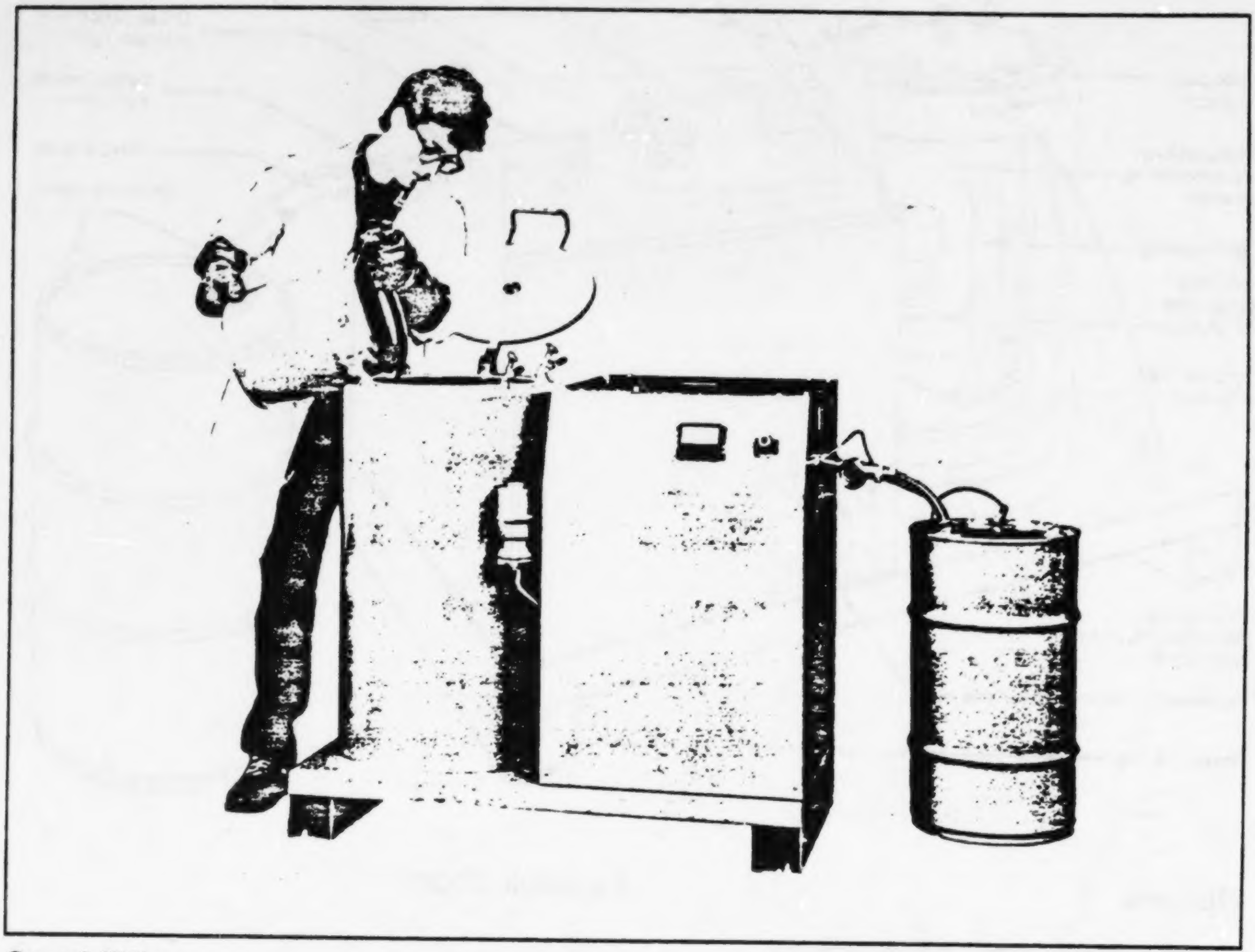
Solvent Distillation Equipment

Model LS-15†

(15 gallons per batch)



Capabilities

- Distills 15 gallons (57 liters) per shift
- Processes alcohols, ketones, aromatics, chlorinateds and aliphatics
- Recovery rates 80-95%
- 99% plus purity
- Residue remains behind in Teflon*-coated STILPAN or optional STILBAG liner

Features

- 4-10 cents operating costs per gallon
- Minimal operator involvement
- Explosionproof electricals meet NEMA 7 (Class I, Division 1, Group D) standards
- Teflon-coated high-conductivity single-piece boiling chamber
- Electric cast encapsulated heating coil (no heat transfer fluid)
- Distillate gravity feed to external receive tank
- Pushbutton operating light

Utility Requirements

Continuous Use

- 1.65 Kw at 110V/1/60 or 50 Hz or 220V/1/60 Hz
- ¼ to ½ GPM condensing water

Optional Use

- 1 to 3 GPM cooling coil water

Specifications

Height:	36 inches	914.4 mm
Width:	44 inches	1117.6 mm
Depth:	30 inches	762 mm
Weight:	425 pounds	191.25 kg

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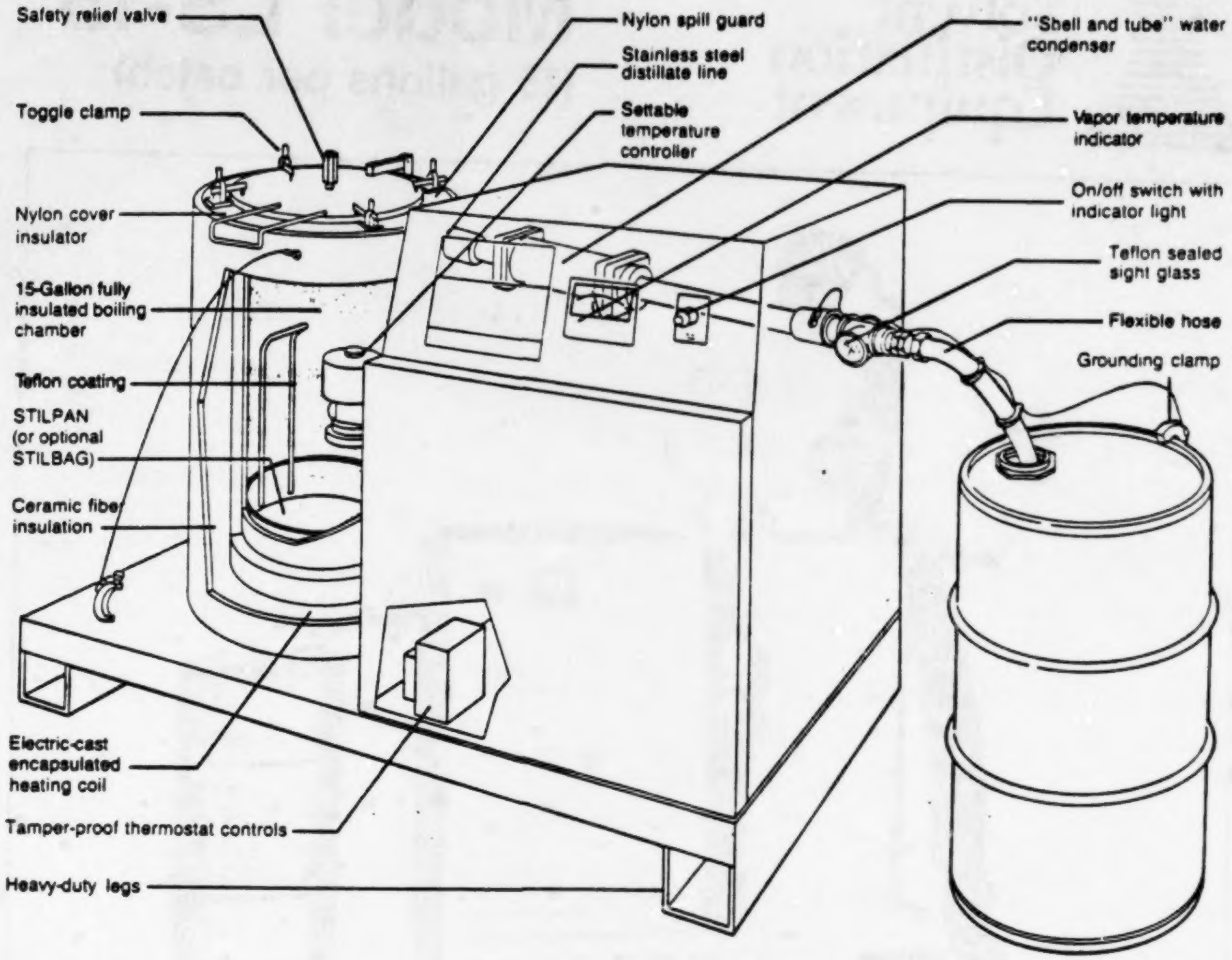
*Du Pont registered trademark

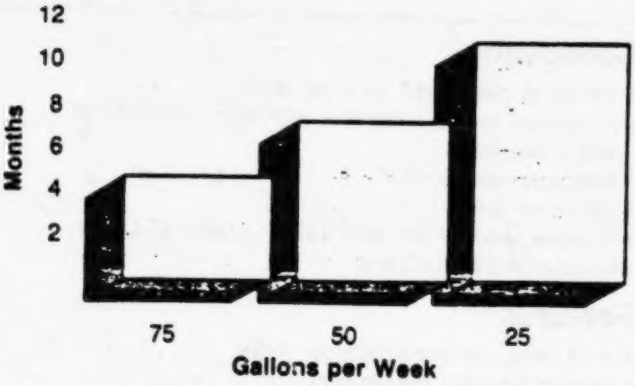
†U.S. Patent 4,488,933


Safety relief valve
Toggle clamp
Nylon cover insulator
15-Gallon fully insulated boiling chamber
Teflon coating
STILPAN (or optional STILBAG)
Ceramic fiber insulation
Electric-cast encapsulated heating coil
Tamper-proof thermostat controls
Heavy-duty legs
Nylon spill guard
Stainless steel distillate line
Settable temperature controller
"Shell and tube" water condenser
Vapor temperature indicator
On/off switch with indicator light
Teflon sealed sight glass
Flexible hose
Grounding clamp

Options

- Vacuum attachment for high-boiling solvents (320-500°F/160-260°C)
- Flow switch interlock
- Non-explosionproof electric timer
- Temperature shut-off with timer
- External venting system

Payback Chart



Typical Operating Costs: 4-10¢ per gallon

FINISH ENGINEERING Co.™
Finish Company, Inc.
921 Greengarden Road • Erie, Pennsylvania 16501-1591 U.S.A.
Phone 814/455-4478 • TWX 510-696-6816

F86-146C-OP

EVAP eliminates water • leaving only solid waste to dispose of.

APPLICATIONS ▸ ▸

Automatic
Parts Washers
Hot Tanks

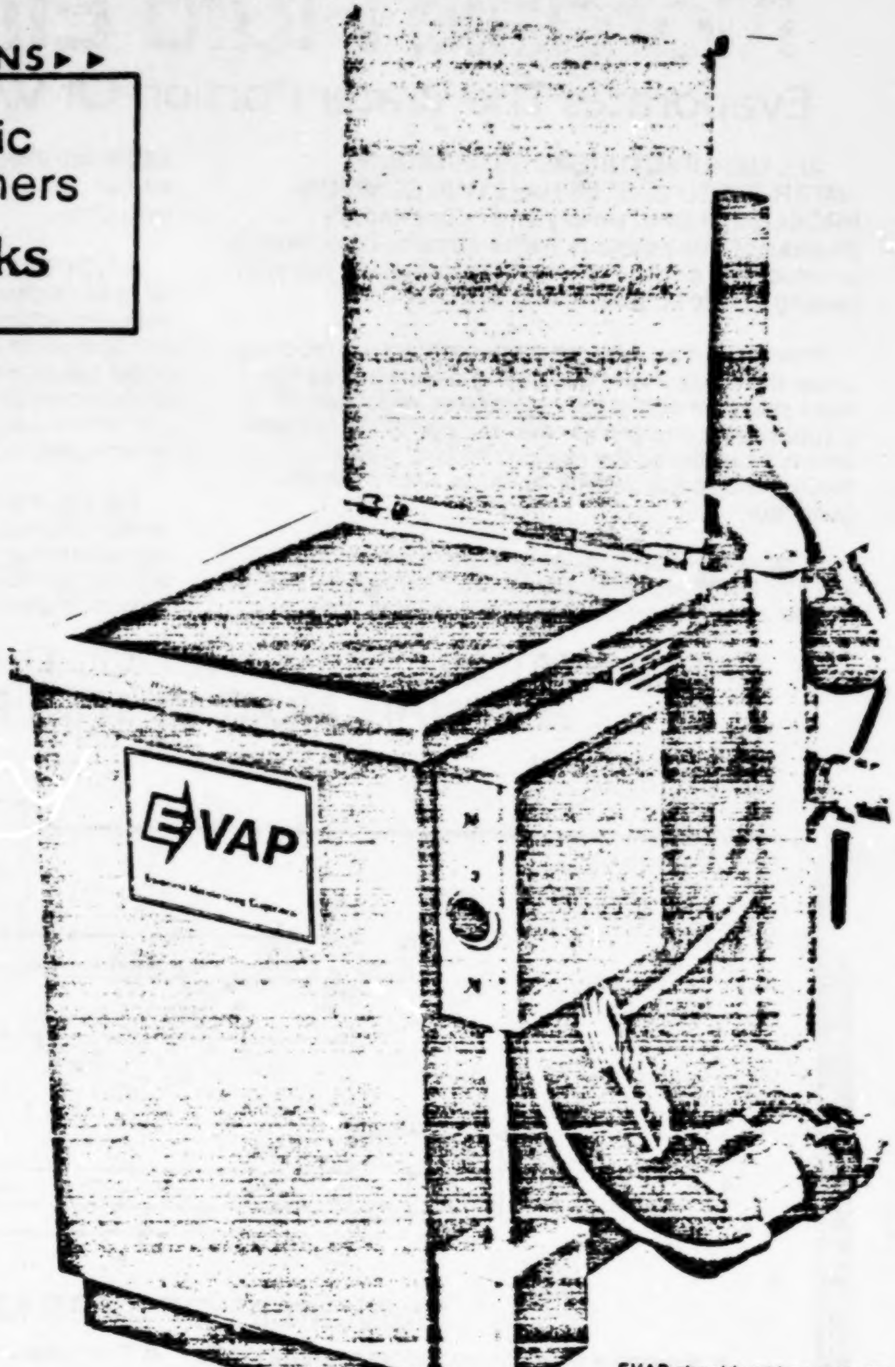
FEATURES

1. No obstruction on tank bottom allowing for easy cleanout.
2. Thru-floor heated
3. Complete reduction of waste.
4. Oil skimmer device for removing tramp oil with 2-inch ball valve.
5. Automatic high temperature shut-off.
6. Insulated tank with polyethylene paint.
7. 85 GPM transfer pump.
8. One year parts warranty.
9. Equipped with leveling legs.

SPECIFICATIONS

. Reduces liquid solution up to 87 percent .

2. Extracts 7 - 10 gallons or more per hour.
3. Estimated cost of disposal 5 to 25 cents per gallon.
4. Power exhaust creates vacuum in EVAP cabinet.
5. Liquid capacity 85 gallon.
6. Electrical on-site conversion within 10 minutes.
7. Power requirements 220 V, 1 Ph., 60 amps., 220 V, 3 Ph., 30 amps.
8. 30 inch width, 37 inch depth and 38 inches in height on the EVAP 85
9. The Model 85 weighs 425 lbs



EVAP should not be used with fluids containing volatile organ compounds or solvents.

EMC

EQUIPMENT MANUFACTURING
CORPORATION
1433 Lidcombe Avenue
So. El Monte, CA 91733
818/575-1644

Nordale Fluid Eliminator

Evaporates The Water Portion Of Water-Based Wastes

ALL MANUFACTURERS GENERATING WATER-BASED WASTES HAVE ONE COMMON PROBLEM: How to simply and economically dispose of this aqueous waste stream. Their need is to reduce the amount of effluent that they are currently hauling off-site or "putting to drain."

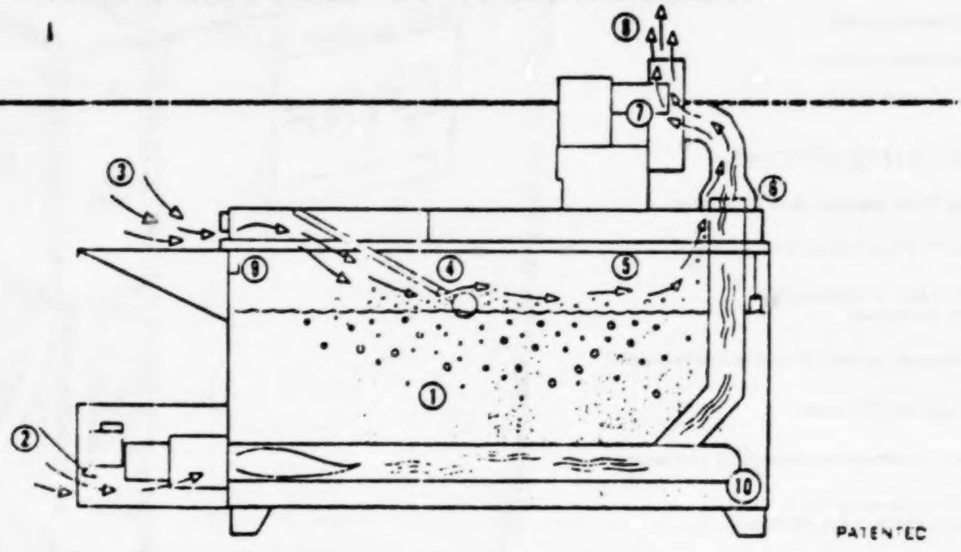
Now more than ever, waste generators are laboring under the pressures of escalating costs and liability, more stringent discharge regulations, reduction of disposal sites and greater public visibility. All of these factors have forced the responsibility of waste minimization back into the hands of each specific generator.

What is the ideal answer to this dilemma? STOP THE WASTE STREAM AT YOUR FACILITY WALLS! This protects you, the generator, against both current and future liabilities, as disposal costs continue to escalate and as compliance regulations become more restrictive.

A NORDALE FLUID ELIMINATOR IS THE ANSWER for many of the generators of aqueous waste. This patented equipment has been designed to evaporate efficiently and economically the water portion of a water-based waste. By converting the water to environmentally safe vapors and segregating the oils and solids, you can reduce dramatically the effluent volume and therefore reduce your costs and liability.

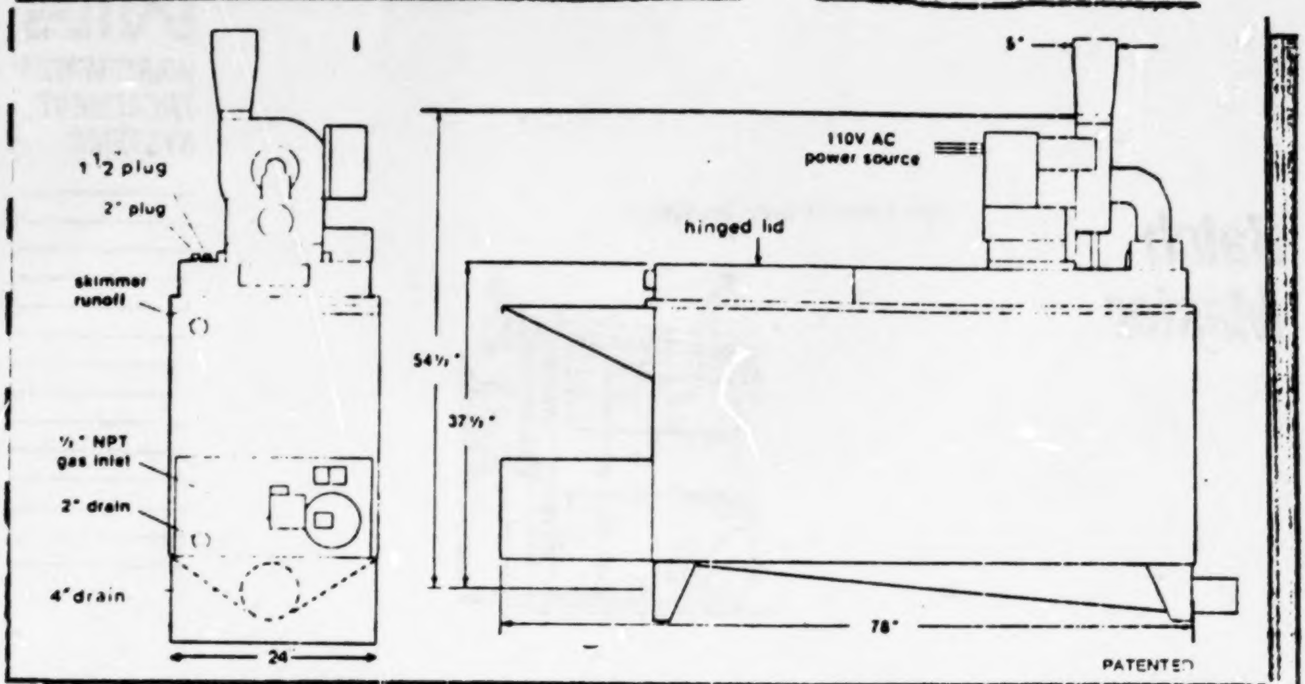
Equally important, the NORDALE unit has been enthusiastically accepted by both environmental consultants and regulatory agencies. It is currently solving clients' waste disposal problems in some of the most stringent compliance states in the country

ELIMINATE MOST OF THE LIQUID AND YOU WILL ELIMINATE MOST OF THE PROBLEM.



PRINCIPLES OF OPERATION

- Solution is heated in the tank to boiling (212° F) by a serpentine gas-fired burner tube.
- Blower fan draws in room air through both the burner tube and an opening in the lid
- Air entering the lid is directed through a passage in the floating baffle.
- The air is drawn across the surface of the heated liquid, sweeping away the vapors as they break surface.
- This moisture saturated air passes through the draft diverter and then mixes with the burner exhaust.
- The reduced mixture, environmentally safe, is drawn through the blower and is released up the stack.
- Free oils and oils whose emulsions have been thermally broken float to the surface. They are then evacuated via an overflow trough into an external waste receptacle
- Precipitated solids settle to the bottom and are easily removed at a convenient clean-out port



SPECIFICATIONS

Electrical Supply: 110V AC
Gas Supply: Natural or Propane
Burner Type: 100,000 BTU Inshot
Burner Tube: 4 inch, 11 gauge seamless boiler tube
Tube Design: Serpentine 17 feet long
Stack: 5 inch diameter or greater
Blower Type: High pressure direct drive 530 CFM (1" SP)
9 inch self-cleaning radial blade wheel
Blower Motor: 3450 RPM, 1/3 HP single phase
Tank Capacity: 150 gallons (flat bottom)
162 gallons (sloped bottom)
Tank Insulation: 1 inch
Weight (Empty): 560 lbs.
Inlet Plugs: 2 inch
1½ inch
Cleanout Ports: Flat bottom — 2 inch
Sloped bottom — 4 inch

FEATURES

- Automatic Pilot
- Burner Switch — Blower Switch
- Skimmer Trough for Easy Oil Removal
- Convenient Cleanout Ports for Solids
- Hinged Lid for Handy Access to Tank Interior
- Floating Baffle, Airflow Control for Efficient Evaporation
- Tank Insulation for Safety and Efficiency
- Requires Only 14 Square Feet of Floor Space
- Batch or Automatic Feed from Holding Tank
- Evaporates 14 Gallons per Hour
- SUITABLE FOR NON-COMBUSTIBLE MATERIALS ONLY

BURNER SHUT-OFF

- Automatic Low Level Float Switch
- Automatic High Heat Switch
- Blower Fan — Lockout to Burner unless Fan Operating
  — Airflow Detection Switch

MODELS

FLAT BOTTOM STYLE
1000-MS Flat Bottom
FE-150 Mild Steel (12 gauge)

SLOPED BOTTOM STYLE
1000 S-MS Sloped Bottom
Mild Steel (12 gauge)

1000 S-SS Sloped Bottom
Stainless Steel (14 gauge)

Nordale *FLUID ELIMINATOR*
9907 Xylite Ave., N.E. • Minneapolis, Minnesota 55434

For technical or national sales information contact:

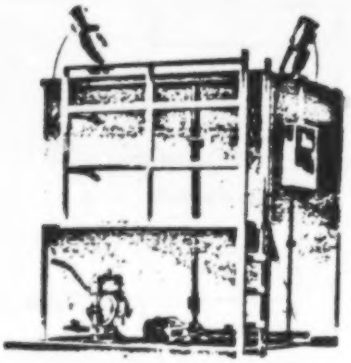
SAMSCO, INC.
42 New Boston Road • Bedford, N.H. 03102
(603) 668-7111

E & K SALES, INC.
14730 E. Firestone Blvd., #307
La Mirada, California 90638
(714) 670-0668

WTS
WASTEWATER
TREATMENT
SYSTEMS

Batch Master

500 Gallon HF Treatment System



Features

- Compact design
- Versatile
- Microprocessor controlled
- Easy to operate
- Economical

Eliminate the rising cost and liability of hauling wet process wastewater with the WTS BATCH MASTER. The BATCH MASTER offers users with low daily volumes of process wastewater, an effective solution to this problem. The BATCH MASTER, equipped with state-of-the-art process controls, efficiently treats several different types of contaminated process water on an "as needed" basis. It is an ideal alternative for users unable to justify a large, continuous flow system.

Description

The BATCH MASTER is a skid mounted, factory assembled batch treatment system consisting of:

- Process treatment chamber(s)
- Chemical feed equipment
- Programmable process controller
- Optional components (based upon individual customer requirements)
  - Filter press
  - Transfer pump(s)
  - Polishing filter — Filtration equipment
  - Storage tank
  - Lift station(s)

The process treatment chamber(s) and skid are combined into a compact, rugged design. All the system components are ready for operation when the unit is delivered. The BATCH MASTER and all system peripherals are operated by a single programmable controller. This centralized approach provides an extremely reliable system that is easy to operate.

Application

The BATCH MASTER is an automatic batch treatment system that can be configured to:

- Neutralize HF and precipitate fluorides
- Destroy cyanide
- Remove heavy metals such as chromates, zinc, copper, tin, nickle
- Neutralize process wastewater
- Remove arsenic
- Reclaim gallium

The WTS BATCH MASTER system finds its greatest application with users generating less than 40,000 gallons of process wastewater per month. The system can also be applied when process wastewater is too concentrated for effective treatment on a continuous flow basis. The BATCH MASTER offers an economical alternative to hauling hazardous liquid waste.

Service

WTS provides the following comprehensive services with **each order:**

Engineering Support

- Site Layout Drawings
- Electrical and System Logic Diagrams
- Operator Manuals

Installation and Start-up

- Complete Hook-up of Unit
- Start-up and Testing
- Operator Training
- Chemistry Balanced to Your Waste

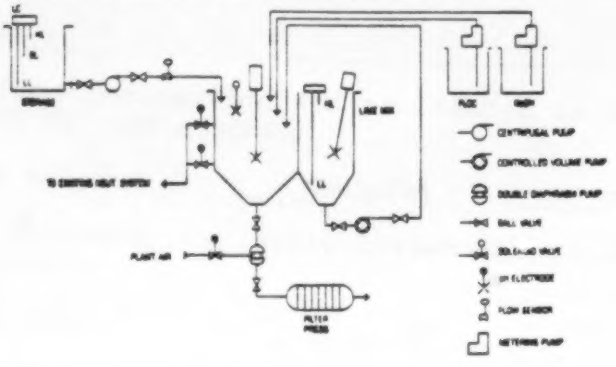
Equipment Maintenance

WTS offers continuous service and maintenance contracts. This is part of our commitment to provide customers with dependable wastewater treatment.

Warranty

All system components are warranted for one year after receipt of the equipment. WTS also guarantees that the process will meet EPA and local receiver pretreatment limits that are in effect at the time of order. (See full warranty and guarantee statement)

P & ID HF BATCH MASTER (1 Batch/Day Operation)


STORAGE
LIME MIX
FLOC
PLANT AIR
FILTER PRESS
CENTRIFUGAL PUMP
CONTROLLED VOLUME PUMP
DOUBLE DIAPHRAGM PUMP
BALL VALVE
SOLENOID VALVE
pH ELECTRODE
FLOW SENSOR
METERING PUMP

Sizing/Construction

The BATCH MASTER is configured to your specific requirements. Typical units are sized to treat 200 to 1200 gallon batches and have space requirements in the range of 16 to 80 square feet.

WASTEWATER TREATMENT SYSTEMS

440 N. Central Avenue
Campbell, California 95008
(408) 374-3030

Document Title WASTE AUDIT STUDY - AUTOMOTIVE REPAIRS

1. Did you find information and procedures in this document to be helpful to your company?

   _____very helpful _____helpful _____not helpful

2. Does the document accurately target the hazardous wastes in this industry?

   _____yes _____no

   If not, what has been overlooked?________________________________
   ____

3. Will information and procedures in this document help reduce waste management costs for your company?

   _____yes _____no

   If yes, please estimate costs or savings. $________________

4. Are you aware of other legal waste management options for this industry which the document does not address?

   _____yes _____no

   If yes please describe________________________________

5. Please indicate your organization:

   _____ Business targeted by Waste Audit

   _____ Consultant

   _____ Government (city, county, state, federal)

   _____ other business/industry

   _____ other (describe________________________)

6. General comments or suggestions:________________________
   ____
   ____

Thank you for your participation.

Please cut from the binder, then fold, staple, stamp, and mail.

B185
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fold line

Benjamin Fries
Department of Health Services
Toxic Substances Control Division
Alternative Technology Section
714/744 P Street
P.O. Box 942732
Sacramento, CA 94234-7320